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CIVIL ENGINEERING.

*Report of the Commissioners Appointed to Inquire into the Application of Iron to Railway Structures.**

Iron roads traverse the land in its length and breadth; binding with their chains the remotest districts of the island, and giving to the inhabitants of Great Britain more completely the character of a united family than they have ever before enjoyed. With the increasing commercial prosperity of our country grew the desire to obtain the means of more rapid communication. Maritime Liverpool pined to draw nearer to manufacturing Manchester, and metropolitan London panted to reach more quickly the metal mart of Birmingham. Of this gradually intensifying desire the locomotive use of steam, with all its incidents, was more than the fulfilment. Hills were broken down, and their debris employed to fill up the valleys,—mountains were bored and rivers spanned,—to make the commercial dream a reality. In carrying out these gigantic tasks, the ordinary materials failing to answer the purpose demanded,—some new one was to be sought: and wood and stone being abandoned, our highways were paved with iron. The iron rail on which the steam-giant toils, with its enormous train, viaducts and bridges, suspended roadways and perforated tunnels, are all constructed from this most important metal.

Though iron has its place in technical history from a very early period, and although man has shaped it into a thousand forms, yet under the new conditions to which it is now so extensively submitted it was soon discovered that we were ignorant of its physical conditions, and particu-

* From the London Athenæum, September, 1850.

larly of its molecular changes. The importance of obtaining this knowledge was pressed on us by more than one painful accident arising from the breaking of cast-iron girders, though they had been previously tested, and proved to be of sufficient strength to support considerably more weight than was to be placed on them. As these accidents had arisen in mills where the iron beams were subjected to the influence of long-continued tremor promoted by the machinery, or on bridges which were submitted to the rapid passage of heavily-laden trains, it was thought that some important molecular change must have taken place in the structure of the iron. This impression received support from the evidence of many experiments. Iron bars were selected which when broken presented a fibrous structure, and these were subjected to long-continued vibratory action; after which on being broken they often showed a crystalline fracture. These experiments have been deemed by many to be fallacious; and we find Mr. Brunel stating that "the same piece of iron may be made to exhibit a fibrous fracture when broken by a slow heavy blow, and a crystalline fracture when broken by a sharp short blow." We are, however, assured by many of our most experienced machinists that iron does undergo a molecular change when subjected to long-continued agitation, and that this injurious change can be always repaired by careful annealing. When we have indisputable evidence of long-continued molecular disturbances under the influences of heat and electro-magnstism, we are disposed to believe in the theory that structural derangement may be produced by merely mechanical causes. It was, therefore, to investigate the subject of the application of iron to railway structures that a Commission was appointed, consisting of Lord Wrottesley, Profs. Willis and Hodgkinson, Capt. James, and Messrs. George Rennie and William Cubitt, with Lieut. Galton as secretary: and well do these Commissioners appear to have performed the duty committed to their charge.

At starting, the Commission endeavored to make themselves acquainted with all the experiments which had been already made on iron by engineers; and on this point they state:—

"From the information supplied to us, it appears that the proportions and forms at present employed for iron structures have been generally derived from numerous and careful experiments, made by subjecting bars of wrought or cast iron of different forms to the action of weights, and thence determining by theory and calculation such principles and rules as would enable these results to be extended and applied to such larger structures and loads as are required in practice. But the experiments were made by dead pressure, and only apply, therefore, to the action of weights at rest. As it soon appeared, in the course of our inquiry, that the effects of heavy bodies moving with great velocity upon structures had never been made the subject of direct scientific investigation, and as it also appeared that in the opinion of practical and scientific engineers such an inquiry was highly desirable, our attention was early directed to the devising of experiments for the purpose of elucidating this matter."

As all railway structures are necessarily exposed to "concussions, vibrations, torsions, and momentary pressures of enormous magnitude

produced by the rapid and repeated passage of heavy trains," it became a question of the extremest importance to ascertain if any, and what amount of change was produced in iron under these influences. It must be remembered that although the injurious action may be in each case exceedingly small, and unworthy of particular notice, it is, from the nature of the material, probable that such derangement has a certain degree of permanence, and that by multiplying the causes a dangerous, and perhaps fatal, result may ensue. We should not be satisfied that the iron bridges spanning our numerous rivers, roads, and valleys; or the tubes which cross the Menai Straits and continue the Holyhead line at Conway, are secure for a few years to come. We should determine the amount of injury, if any, which is produced by the passage of every train, and so secure these structures that they may be maintained in perfect safety, with ordinary attention, for any period of time. To ascertain the effects of moving weights, a well devised apparatus was constructed in Portsmouth Dockyard, and a very extensive series of experiments made by Capt. James and Lieut. Galton. "The results which they obtained were equally new and important, developing for the first time the fact that *a given weight passing rapidly along a bar produces a greater deflexion in that bar during its passage than it would have done had it been suspended at rest from the centre of the bar.*" That is to say, a much less load will break an iron bar when moving rapidly along it, than will fracture it in a state of rest. In the report we are informed:—

"Thus, for example, when the carriage loaded to 1120 pounds was placed at rest upon a pair of cast iron bars, 9 feet long, 4 inches broad, and $1\frac{1}{2}$ inch deep, it produced a deflexion of six-tenths of an inch; but when the carriage was caused to pass over the bars at the rate of ten miles an hour, the deflexion was increased to eight-tenths, and went on increasing as the velocity was increased, so that at thirty miles per hour the deflexion became $1\frac{1}{2}$ inch; that is, more than double the statical deflexion. Since the velocity so greatly increases the effect of a given load in deflecting the bars, it follows that a much less load will break the bar when it passes over it than when it is placed at rest upon it; and accordingly, in the example above selected, a weight of 4150 pounds is required to break the bars if applied at rest upon the centres, but a weight of 1778 pounds is sufficient to produce fracture if passed over them at the rate of thirty miles an hour."

The Commissioners properly insist, therefore, on the importance of giving to all railway structures an amount of solidity far superior to that which is found by experiment or calculation sufficient to support as a dead weight the heaviest loads that can ever travel over them.

A most important series of experiments by Mr. Eaton Hodgkinson on the tensile and crushing strengths of iron under a great variety of forms and conditions, which form Appendix A to this Report, must prove of the utmost value to engineers; so will the mathematical investigation of the subject by Prof. Willis and Mr. Stokes.

It is shown by some carefully conducted experiments made by Capt. James that the strength of iron bars is not increased with their diameters; owing to the circumstance of their assuming a crystalline structure in the middle during the process of cooling, which goes on, of course, more slowly there than on the outside of the bar. This has been frequently

observed in large iron castings; but we are not aware of any published set of experiments which so satisfactorily show the great importance of annealing all iron girders, and of limiting the thickness of each mass of iron employed for supporting heavy, and particularly moving, weights, as Capt. James's. This thick Blue-book and its accompanying volume of plates, we must regard as a valuable contribution to scientific engineering. It is, however, to be regetted that the experiments of the Commission did not embrace the effect of wrought iron tension bars on cast iron girders as applicable to such structures as the Dee and numerous other bridges of a similar construction. By some this form has been absolutely condemned as insecure; while other engineers still contend that it may be employed with safety.

We understand that the labors of this important Commission were prematurely stopped by cutting off the necessary funds for carrying on the experiments. Surely, seeing the important uses to which, on land and sea, iron is now employed, it was not a wise economy to put an end to an inquiry which promised to be of such great national importance.

Description of the Insistent Pontoon Bridge, at the Dublin Terminus of the Midland Great Western Railway of Ireland. *By* Mr. R. MALLET, M. Inst. C.E.*

This bridge was stated to be situated on the line of approach from the city to the terminus, and formed a passage over one branch of the Royal Canal, where it crossed the Phibsborough road, upon the Foster Aqueduct. By the act it was provided that the navigation of the canal should be as free and unimpeded as possible; and from the circumstance of there being only a height of 16 inches between the intended surface of the road and that of the water of the canal, it necessarily involved the placing of some kind of movable bridge, of rather peculiar construction. After due consideration, the one described in the paper was designed and adopted, as being more suitable to the peculiarities of the situation than any other, owing to the water channel being only 17 feet 4 inches in width, and that the passage to be made across it required to be at least 50 feet in breadth.

The general idea of this form of movable bridge was that of a pontoon, or flat-bottomed boat, constructed of iron; the breadth being nearly equal to that of the water space to be crossed, and the length about equal to the width of roadway required. The deck beams of this pontoon projected over the sides, and rested while *in situ*, upon a rabbate, or continuous recess, formed along the top course of each quay-wall, but while the pontoon was floating light, the projecting deck-beams were 2 inches clear of this rabbate, and the roadway platform, constituting the deck of the pontoon, was elevated to an equal height above the level of the top of the quay-walls, or land on each side; in this state the pontoon could be freely and readily pushed along the canal, for a distance of rather more than its own length, until it was brought opposite to a lye-by, provided by increasing the width of the canal at this point, and being put therein, the navigation was perfectly free.

* From the London Architect, April 25, 1850.

As a pontoon afloat would form a very unstable roadway for carriages, means were provided for allowing it to settle down in the water, and rest firmly upon the rabbates: and also for again raising it rapidly, so as to float clear of the rabbates, and enable it to be moved away into the lye-by. For this purpose two large valves were placed in the bottom of the pontoon, one near each end, by which water was allowed to enter, and sink the pontoon, until it hung upon the projecting deck-beams. For removing this water, when it was required to float the pontoon, a large syphon, of a particular construction, was provided, which was capable of being brought instantly into use, and of being as quickly detached, when a sufficiency of water had been withdrawn to enable the pontoon to be moved. These operations were stated to be performed very readily by one man, the navigation being cleared in four minutes, and the roadway restored in less than three minutes.

The details of the construction of the pontoon, of the syphon, and all other parts of the work, were then minutely given; also, the total cost of the structure, which, exclusive of the masonry, was 1125*l.*, that of the masonry being about 150*l.*; and it was stated to have continued in use, with perfect satisfaction, since its completion in February, 1847.

This form of construction was considered to be applicable in situations where a comparatively narrow water channel had to be crossed by a very wide roadway; but as the particular circumstance of other localities might differ from the one in question, the author suggested various alterations in the details, so as to meet these exigencies.—*Proc. Ins. Civ. Eng.*

Description of the Ballochmyle Viaduct over the River Ayr, on the line of the Glasgow and South-Western Railway. By William M'Candlish, Esq., *Resident Engineer.*[*]

This viaduct, it was stated, carries the Cumnock Extension of the Ayrshire Railway (which, on amalgamation, becomes part of the Glasgow and South-Western Railway,) over the river Ayr, about a mile from the village of Mauchline. In order to attain the summit of the country near Cumnoch, the line required to cross this river at an elevation of 178 feet above its bed. The river is about 100 feet wide, and runs between high rocky banks, which are used as abutments from which to spring the great arch. The viaduct consists of seven arches, the centre one being 180 feet in span, and the three on either side of it being 50 feet in span each, and all semicircular in form. The arch stones of the great arch are, on the outside, 5½ feet deep at the springing, and 4½ feet at the crown, but inside they were about a foot deeper. To give an idea of the magnitude of the viaduct, let it be compared with the Dean Bridge, near Edinburgh. If placed with the river bed on the same level as that of the Ayr, the roadway would stand 65 feet below that of the Ballochmyle bridge, and the great arch of the latter would span two arches of the former. Again, if Lord Melville's monument in St. Andrew's square were placed beneath the great arch, the head of the statue would not reach the crown of the arch. The stone of which the bridge is built is

[*] From the Glasgow Practical Journal, August, 1850.

a close grained red freestone, and was obtained from quarries opened on either side of the river, being conveyed to the bridge along service railways, which conducted to a gangway erected across the valley in connexion with the centering. From this gangway they were removed to their positions by means of traveling cranes, stretching across the whole building. The centering was erected in four stages, each stage being proceeded with as the building advanced, and consisted of whole logs of memel, placed one above another, and properly connected, at each stage, with cross ties and diagonal braces, and well secured by bolts, &c. The quantity of timber used was about 50,000 cubic feet, and of iron about six tons. The work was commenced in November, 1845, the great arch was keyed on 8th April, 1847, and the last stone was laid on 14th March, 1849; the building being completed within three years and four months from its commencement. The number of men employed averaged about 400; and, to the credit of Messrs. Ross and Mitchell, the contractors, and Mr. Fulton, their superintendent, not a single serious accident occurred during the execution of the work. During its progress, it was visited by vast numbers of people from all parts of the country, attracted by the beauty of the scenery and the grounds, as well as by the interest attached to the operations which were going forward. The quantity of stone used in the viaduct was about 530,000 cubic feet, and the total cost of the work was about £41,000.—*Proc. Roy. Scot. Soc. Arts.*

AMERICAN PATENTS.

List of American Patents which issued from October 15th to November 5th, (inclusive,) 1850, with Exemplifications by CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

OCTOBER.

43. For an *Improvement in Braces for Carriage Tops;* John L. Allen, New Haven, Connecticut, October 15.

Claim.—"What I claim as my invention, is the construction and arrangement of braces for carriage tops, so that when one limb or part of the brace is turned upon a prop, fulcrum or pivot, all the joints of such brace are simultaneously moved, or operated substantially, as shown in the drawings.

"I also claim the adaptation of a graduating strap, loop, or similar device, so as to secure the top at any desired elevation, as herein set forth."

41. For *Improvements in Filtering Cocks;* Daniel Bartlett, Jr., Boston, Massachusetts, October 15, 1850.

Claim.—"What I claim as my invention, is the combination of parts arranged, constructed, and made to operate together substantially in the manner hereinbefore set forth; the said combination consisting of the box or case, the tubular passage way, having three discharging orifices, the turning or hollow plug, made with a discharging orifice, the central and two lateral chambers, the passages connecting the openings with the chamber, the self-operating valves, and their stem and seats, and valve openings, the passages leading out of the bottom of the two lateral chambers, the central discharge pipe leading out of the chambers, the partitions, and the filtering medium, having wire gauze chambers as above specified, or being used without them, as occasion may require."

42. For an *Improvement in Looms;* Amos H. Boyd, Saco, York County, Maine, October 15.

Claim.—"I lay no claim to spring motions, as they have been usually constructed and

made to operate, but what I do claim as my invention, is the combination of the vibrating posts and springs applied to them, as arranged and adapted to the loom frame, and the operative parts with which they are connected, substantially in the manner and for the purpose of easing the web, without varying its horizontal position as hereinbefore specified."

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43. For an *Improvement in Machines for Pulverizing Sugar;* Oliver R. Chase, Boston, Suffolk County, Massachusetts, assignor to Silas E. Chase, Charlestown, Massachusetts, and Oliver R. Chase, Boston, Massachusetts, October 15.

"The external or first part of my invention consists of a cylindrical vessel or mortar, made of cast iron or other suitable material, and of such thickness and dimensions as circumstances may require."

Claim.—"What I claim as my invention, is the combination of a rotative series of cells, a rotative series of stampers, suitable machinery for actuating the stampers, and a cylindrical mortar, when arranged and made to operate together, and to receive, pulverize, and expel sugar, or other material, substantially in the manner as hereinbefore specified."

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44. For an *Improvement in Hemp Harvesters;* William Baily Coates, Big Lick, Virginia, October 15.

"Having described the drawings, and referred to the parts by letters, I shall proceed to state the particular nature of my invention. This consists in placing choppers, with their edges so as to strike obliquely, on a rock shaft—that by a lateral and semi-rotary motion combined, they may cut an oblique stroke against the top and right edges of the teeth. In obtaining this motion I employ a male and female screw as before described. Also in placing a light frame with a spring bottom to catch the hemp when it falls back. This frame can be made with the rods closer to the back long transverse piece of frame, and placing the long pieces closer together, it would then catch rye, wheat, &c."

Claim.—"What I claim as my invention, is:

"1st. The box on the right marked Q, which is a constant oil retainer.

"2d. The combined sides, and spring bottom for catching and laying the hemp, &c.

"3d. I claim casting (or securing in any firm manner) choppers on a rock shaft, with the edges chisel shaped, and set so as to strike obliquely against the top and right edges of the teeth, when the part moves by a lateral and semi-rotary motion. In procuring this combined motion, I employ a male and female screw thread as already fully described in the preceding part of these papers. I do not desire to be understood as confining myself to the screw in getting this motion in N, but will employ any other method most suitable to produce the desired result, and which shall be substantially the same."

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45. For an *Improvement in Grain Cradles;* Isaac T. Grant and Daniel H. Viall, Schaghticoke, Rensselaer county, New York, October 15.

Claim.—"What we claim as our invention, is the particular construction and arrangement of the brace rods C, so as to fold down upon the fingers, as shown in Fig. 2, each being bent in the proportionate angle fitting their respective localities, the ends thus bent pass through the fingers perpendicularly at *d*, and are secured by riveting the same upon the upper side of the fingers, which shape and form given to the wire braces, forms and constructs a hinge joint, and each may be turned or swayed in the direction desired, and when separated from the sneath, each wire brace is placed in the position as is represented by Figure 2, aforesaid, permitting large numbers to be packed in a condensed form, in packages or boxes convenient and proper for removal, storage, or transportation, substantially the same as herein set forth and described."

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46. *For* an *Improvement in Pegging Jacks;* Jacob Jenkins, Andover, Essex county, Massachusetts, October 15.

Claim.—"What I claim as my invention, is the combination of the two jaw blocks, and the double spring connecting rod, as constructed and made to operate together, and in connexion with the other parts of the apparatus substantially as herein above specified."

47. For an *Improvement in Machines for Folding Paper;* George K. Snow, Boston, Massachusetts, October 15.

Claim.—"My invention consists principally in a combination of machinery or parts, in which the sheet is *not seized, completely folded, and delivered,* by converging and moving surfaces, such as two series of endless tapes and rollers: I make use of no such contrivances, and their operative machinery, in combination with a *mere bar* or contrivance for acting against the middle of the sheet, and pressing such middle part between such converging surfaces which *seize the sheet, draw it away* from the said bar or contrivance, *complete the fold,* and deliver the paper."

Claim.—"My improvement or combination, as invented and claimed by me, consists of the following elements: 1st, a slotted plate, table, or contrivance, for receiving and supporting the sheet. 2d, Two parallel planes or plates, extending at right angles from such support, and so arranged, that there shall be one of the said plates on each side of the slot, of the first element or support of the sheet. 3d, A striking and folding frame or plate, so arranged and operated as to press the paper against the middle or other proper part of it, force it downwards through the slot, and between the two parallel plates; the said parallel plates operating to complete the fold, and to hold the sheet of paper during the return or retrograde movement of the sliding frame or plate. And in combination therewith I claim a second striking and folding plate arranged at right angles to the said two parallel plates, and made so to pass or operate through them or their slots, and directly after the said retrograde movement of the first one, as to press against the sheet of paper, and force it through one of the said slots, and thereby once more or a second time fold it.

"And I claim in combination with such second combination of mechanism, a third striking and folding plate, and slotted parallel folding plate, and friction rollers, or equivalent contrivances, the same being for supporting the twice folded sheet of paper, folding it a third time, and subsequently discharging it, such discharge taking place in consequence of the return or retrograde movement of the striking or doubling plate as above described.

"And I also claim the combination of mechanism which is applied to the striking plate and its rollers, or folding contrivances, and used for packing the sheets; the said mechanism consisting of the stationary plate, and the spring plate, or plate and its springs, or other proper equivalents, which permit the recession of the plate in proportion as the pack of sheets increases in size; the whole being arranged and made to operate, substantially in the manner as herein before specified."

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48. For an *Improved Machine for Excavating and Conveying Earth;* John A. Sprague, Dayton, Montgomery county, Ohio, October 15.

"The machine consists of wheels, axles, tongue, and forward bolster, of a common two horse wagon, the fore and hind axles of which are coupled together by a frame, upon which, near the fore end is a windlass, consisting of a lower cross timber, and two upright timbers, and an upper cross timber, and an iron shaft, and a rag wheel, and a crank."

Claim.—"What I claim, is the combination of the series of elevators with the scoop and a rising and falling earth bed furnished with an apparatus for emptying the same, the whole arranged and acting substantially as herein described.

"I also claim a regulator to the scoop attached in the manner and for the purposes herein specified."

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49. For an *Improvement in Molasses Gates;* Erastus Stebbins, Chicopee, Hampden county, Massachusetts, October 15.

Claim.—"What I claim is the arrangement of the spring, the turning shaft and their bearings, at one end of the gate, and on the side of the screw or seat tube, substantially in the manner above specified, the same giving to my improved molasses faucet several important advantages over that described in the said patent numbered 3002."

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50. For a *Maize Harvester;* William Watson, Chicago, Cook county, Illinois, October 15.

"My invention consists, 1st, in a new method of gathering the ears of Indian corn from the standing stalks by means of a fork which is mounted upon a carriage, and is advanced forwards by horse or other power against the standing stalks beneath the lowermost ears; as the fork is advanced, the stalks are received between the prongs, which near their junc-

tion are sufficiently close to each other to retain the ears of corn, while the stalks, being held to the ground by their roots, drag between the prongs and remain upon the field.

"The second part of my invention, which is subsidiary to the first, consists in adapting to a carriage on which one or more gathering forks are mounted, an apparatus, by means of which, the gathered ears are husked and shelled."

Claim.—"What I claim as my invention, is the method substantially as herein described of separating the ears of Indian corn from the standing stalks on which they grow.

"I also claim in combination with gathering forks, apparatus for husking and shelling the corn substantially as herein set forth, whereby the gathering, husking, and shelling of corn are performed at a single operation."

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51. For an *Improvement in Suspender Buckles;* Charles Benedict, Waterbury, New Haven county, Conn., assignor to the Hotchkiss and Merriman Manufacturing Company, Waterbury, Connecticut, October 22.

Claim.—"What I claim as my invention is, the connecting of the wire forming the tongue of the buckle to the outside plate, by means of an eye or hinge formed by bending over a portion of the plate, thus making the whole buckle of but two pieces of metal, also bending or forming the wire which forms the tongue of the buckle in such a manner as to make a lateral spring for securing itself in its proper place; and also the method of securing the points of the tongue by the lateral hooks or guards curved from the sides of the plate in such a manner, as to receive and partially or entirely cover the points of the tongue, and the whole of these contrivances arranged, connected and combined, substantially as herein described."

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52. For an *Improvment in Feeding Apparatus for Straw Cutters;* Henry W. Bertholf, Sugar Loaf, Orange county, New York, October 22.

"The nature of my invention consists in the arranging of the feed box obliquely to the action of the cutters, so as to cut the straw or stalks lengthways or nearly so. Also in arranging the mouth of it, so as to compress the straw or stalk, by means of a lever, weighted or operated by manual pressure, when the knives are in the act of cutting, and thereby preventing it from slipping or drawing from under the edges of the knives."

Claim.—"What I claim, is the use and employment of the adjustable and compressing lid, in combination with the feed roller, and a cutting box having an adjustable block piece to contract the mouth of it, and so arranged as to present the straw or stalk obliquely at different angles, to the action of the knife, and compress it while under its edge, substantially in form and manner as herein set forth."

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53. For an *Improvement in Cheese Presses;* Joseph Card, Fairport, Lake county, Ohio, October 22.

Claim.—"What I claim therein as new, is the elastic strap for raising the platen rod, arranged and operating substantially as herein set forth."

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54. For *Improvements in Machines for Making and Holding Cores for Casting;* Luther H. Crocker, Cincinnati, Ohio, October 22.

Claim.—"What I claim as new, is the combination of the two moving jaws with the stationary piece, said moving jaws being shaped and actuated substantially, in the manner and by the mechanical devices herein specified.

"I also claim keeping the cores straight and stiff in the flasks without the use of anchors, by means of contrivances substantially such as are herein described."

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55. For *Apparatus for Reversing or Stopping Locomotive Engines;* James Cunningham, Reading, Berks county, Pennsylvania, October 22.

Claim.—"What I claim as my invention, is the arrangement and connexion of the system of devices, consisting substantially of a rock shaft, with its hand lever and arms, link-rods, helical segment, drum, sliding key, and oscillating arms, together with the eccentrics and valves, with their respective rods, by means of which the movement of the steam valves of a locomotive engine can be arrested or reversed, with proper lead to reverse the motion of the locomotive, by a single movement of the hand."

56. For an *Improvement in Cotton Presses;* J. T. Elliot, Carrolton, Carrol county, Mississippi, October 22.

Claim.—"What I claim as my invention, is the employment of the press herein described, so arranged that it may be conveniently charged in an upper story of the building in which it is placed, and actuated and uncharged in a lower story of the same, substantially as herein set forth."

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57. For an *Improvement in Subsoil Ploughs;* William C. Pagett, Xenia, Green county, Ohio, October 22.

Claim.—"What I claim as my invention, is the scoop instrument, with the combination of the cutters in the rear, as a subsoil plough."

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58. For an *Improvement in Apparatus for Releasing Horses from Carriages;* Tapley B. Pyron, Salina, Jackson county, Tennessee, October 22.

Claim.—"What I do claim as my invention, is combining two tapered trace bars with the flexible lever or disengaging strap attached to the upper end of the the curved confining box plate, projecting outward from the swingletree, in which the flexible lever and ends of the tapered trace bars fit and are properly secured with the traces; by the curve of the box plate and a guard or holder attached to the flexible lever, and fitting into the cavity of the box plate directly over the ends of the trace bars, the disengagement being effected by drawing a cord attached to the flexible lever, which will cause it to approximate to a straight line, and with it elevate the ends of the trace bars, and liberate the same from the curved box plate, as fully set forth."

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59. For an *Improved Wrought Iron Railroad Chair;* Edward S. Renwick, City of Washington, October 22.

Claim.—"What I claim as my invention, is a wrought iron railroad chair, with lips formed from that portion of the plate on which the rail is usually supported, substantially as herein set forth."

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60. For an *Improvement in Preparing Beef-steaks for Cooking;* Thomas G. Stagg, City of New York, October 22.

"The nature of my invention consists in employing two rollers having conical or other shaped teeth, by forcing the meat between which rollers, the said teeth are made to act perpendicularly and laterally on the meat, bruising the fibres thereof, and bringing out the juice without mashing or flattening the meat; the upper roller to be supported on a movable lever, that the pressure may be regulated according to the toughness of the meat, or to raise said roller to allow a bone to pass through."

Claim.—"What I claim as my invention, is the preparing beef and other steaks for cooking by running them through toothed rollers, substantially as set forth and described in the specification and drawings."

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61. For an *Improvement in Fastenings of Coulters to Ploughs;* Austin Whittlesy and Austin K. Whittlesy, Spring Port, Cayuga county, New York, October 22.

"The nature of our invention consists in arranging and combining, by a new mode of construction, the different parts of the plough, so as to give greater strength and durability than any other known or used."

Claim.—"What we claim as our invention, is the construction of the double plates, held in parallel position by the combined action of the coulter and the bolts, substantially as described, and for purposes above set forth."

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62. For an *Improvement in Processes for Manufacturing Alum;* Jacob Henry Wurtz, City of New York, October 22.

"The nature of my invention consists in obtaining alum from green sand, by the action of sulphuric acid upon it."

Claim.—"What I claim as my invention, is the obtaining of alum by the action of

sulphuric acid, or its equivalent, upon the substance called green sand, green sand marl, or simply marl."

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63. For an *Improvement in Printing;* Bartholomew Beniowski, London, England, October 29; 1850; anté dated November, 1846.

Claim.—"That which I consider new in the above described improvements, is, 1st, marking on the shanks and foot of types by any convenient means, such as writing, engraving, casting, or electrotyping, the same letter or character which is formed on its upper surface, and also the method herein shown and described of casting the intaglio letters on the shank and foot of the types at the same time that the type itself is cast.

"2d, Making types having, in combination with the usual letters in relief on the face of the type intaglio letters on the foot thereof, for the purpose of serving as matrices from which to obtain a polytype plate, while the types themselves will serve for printing.

"3d, I claim casting spaces on the sides of ordinary type, for the purpose above mentioned, as above described.

"4th, I claim the peculiar mode herein shown and described of poly-composing, either from the ordinary cases, or from what I call the authoriton.

"5th, I claim the process and apparatus herein shown and described, for facilitating the sorting and distributing of types and spaces, and making part of them of wood and iron, so that the wooden portion may be separated by means of water, the iron ones by a permanent or temporary magnet, and the others into their several receptacles by hand, the workman being considerably assisted in this operation by the type being marked on their sides.

"6th, I claim the apparatus shown in figures 8, 9, and 10, which I denominate the 'authoriton,' and also of the use of the copying sticks shown in figures 13, 14, and 15, for the purpose of facilitating composition, by which the above described types are brought into a convenient space for composing from, as herein before described."

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64. For an *Improvement in Electro-Magnetic Enunciators for Signals in Hotels, &c.;* Charles S. Bulkley, Macon, Bibb county, Georgia, October 29.

Claim.—"What I claim as my invention in my improved electro-magnetic enunciators for hotels, &c., is the manner in which the signal bell, and any one of the signal plates, can be simultaneously acted upon at a distance from the enunciator, through the medium of the galvanic battery; the series of electro-magnets, A and *g g*, and the wires connected with each other with the insulated point, and the shank of the knob, located within the walls of the different rooms, and with the bell and signal plates of the insulator, substantially in the manner herein set forth."

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65. For an *Improvement in Winnowing Machines;* J. G. Goshon, Shirleysburg, Huntingdon county, Pennsylvania, October 29.

"My invention consists in the combination and arrangement of a rotating screen, of the form of a frustrum of a cone, composed of two or more sections of different sized meshes, and placed transversely in the position heretofore occupied by the fan and the usual large fan case of the mill."

Claim.—"What I claim as new, is the combination of the additional bottom board with the elevated fan and fan case, for the purpose of diminishing the space between the discharging board and screens for concentrating the blast beneath, and in contact with the screens, for the purpose described."

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66. For an *Improvement in Car-Couplings;* Nathan Haskins, Hillsborough county, New Hampshire, October 29.

Claim.—"What I claim as my invention, is the improvement whereby the cars are connected or disengaged under the above named circumstances; or, in other words, I claim the combination of the suspended extension pin, with its weighted pin or arm, or any mechanical equivalent therefor, the hinge and the buffer socket to which they are applied, the same being constructed and made to operate substantially as set forth."

67. For an *Improvement in Corrugated Boilers;* Richard Montgomery, City of New York, October 29.

"This invention consists in forming cylindrical flues, the curved fire arches, and if deemed advisable, the curved shells of boilers of corrugated metal."

Claim.—"What I claim as new, is the employment of corrugated plates of metal for forming the curved arches of fire chambers and shells of steam boilers, the corrugations running in the direction of the curves, substantially as described."

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68. For an *Improvement in Bedstead Fastenings;* John Morrison, McArthurstown, Vinton county, Ohio, October 29.

"The nature of my invention consists in constructing a bedstead fastening by means of a triangular piece of flat iron, the vertex of which is elongated, and in which is cut an ellipse, and in the end of each arm, or of each of the other angles of the triangle, is a hole, which piece of iron being fastened to the post by means of pins passing through the holes in each arm of the piece of flat iron, and by means of a screw or pin, having on it an eccentric or cam, and passing into the rail at the outer extremity of the ellipse, the post is drawn firmly to the rail by turning the screw, until the cam presses against the piece of iron at the outer extremity of the ellipse."

Claim.—"What I claim as my invention, is the construction and application of a triangular or forked plate of iron, made in such a manner as that it can be secured to its place, and draw the post and rail firmly together by means of an eccentric or cam, substantially as above described."

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69. For an *Improvement in Rotary Grain Screens;* Dan. Pease, Jr., Floyd, Oneida county, New York, October 29.

Claim.—"I claim the construction of a rolling screen, consisting of a large and fine, and small and coarse, part, in combination with conductors to carry the grain from the large to the small part, for the above mentioned purpose, and substantially as above described."

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70. For an *Improvement in Machinery for Pressing Hats;* Bennett Potter, Jr., Templeton, Worcester county, Massachusetts, October 29.

Claim.—"I am aware that the smoothing irons in machines for pressing palm-leaf hats have been mounted on a carriage, by which they could be simultaneously brought over the press block into the proper position for the hat to be pressed against them by a second movement, by which the block is raised or the irons depressed. I therefore do not claim merely so arranging the smoothing irons that they can all, by a single movement, be simultaneously brought over the block; I only claim this when the irons are also at the same time, and by the same movement, brought into the requisite contact with the top and sides of the crown, and with the brim of the hat, to smooth and compress the same, substantially as herein specified.

"I likewise claim the devices herein described, or their equivalent, for rendering the crown-iron self-adjusting with respect to the brim-irons, so that the pressure of the crown-iron will be co-etaneous with that of the brim-irons, without affecting the relative degree of pressure with which they respectively bear upon the surfaces to be smoothed by them, substantially as herein set forth."

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71. For *Improvements in Machines for Making Wrought Iron Car Wheels;* Nathan Starks, Albany, New York, October 29.

Claim.—"I claim as my invention, the forging of solid wrought iron wheels, when made by drop and dye, the use ofa lower die or anvil, made to revolve during the process of forging, horizontally on a centralvertical axis, either by hand or by the machinery which operates to drop the ram or hammer, substantially as set forth in the above specification."

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72. For an *Improvement in Reed Musical Instruments;* James P. Sleeper, Worcester, Massachusetts, October 29.

Claim.—"What I claim as my invention, is the improvement of the vibration string or

strings, wire or wires, in their combination with the wind chest, the same being made to be vibrated by the air in its passage into or through the wind chest, substantially as specified.

I also claim the above described extension or elongation of the passage, in combination with the improved arrangement of the reed and valve opening, the said arrangement consisting in placing the reed not directly over the valve opening, but at a distance therefrom, and in said passage substantially as specified."

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73. For *Improvements in Machines in Nicking the Heads of Wood Screws;* Thomas J. Sloan, City of New York, October 29.

"The first part of my invention consists in interposing a spring between the griping jaw and the cam or lever which gives the griping motion, that the machine may be self-adapting to the varying sizes of blanks.

"And this part of my invention also consists in so forming or connecting the spring, that its tension may be regulated to suit large and small blanks.

"The second part of my invention consists, in forming the cam which gives the griping operation with a recess or depression, so that directly after the blank has been seized by the jaws, they shall be partly opened for a while, to permit the blank to fall by gravity into its proper position before it is finally griped, to be presented to the nicking saw."

Claim.—"What I claim as my invention, is interposing a spring between the griping jaw and the lever or cam by which it is operated, in the manner substantially as herein described, and for the purpose specified.

"I also claim making the spring which is interposed between the griping jaw and the mechanism which operates it, so that its tension can be varied and regulated in the manner and for the purpose specified.

"And I also claim causing the griping jaw to open slightly after it has seized the blank, to permit the blank to assume its proper position between the jaws before it is finally griped, in manner substantially as herein specified."

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74. For *Improvements in Spike Machines;* Horatio N. Swift, Boonton, Morris county, New Jersey, October 29.

"My invention consists of a machine which will manufacture railroad spikes with great rapidity and perfection of form, giving each spike the proper shaped head, and insuring the bending of it at the proper angle and direction. The spikes are cut off, headed, and completed at one operation, and from the construction of the machine, are necessarily exactly alike in form and size."

Claim.—"What I claim as new therein, is, First, the adjustable cutter when in such position with regard to the dies for holding the spike, that the rod forming the spike is both cut off, and the proper bend given to it to form the head at one and the same operation, during which the spike is held stationary, substantially in the manner described.

"Second: I claim the jaw of the swage, kept open by a spring, in combination with the moving swage, and the stationary swage, the swage (2) having an inclined face, which acting on a similar face on the back of the jaw (3) closes it, for forming the point for the spike, whether placed in front of the revolver to point the rod, or behind it to point the spike, constructed substantially as described."

Re-Issues.

1. For an *Improvement in Shanks of Door-knobs;* L. R. Livingston, John J. Roggen, and Calvin Adams, Pittsburg, Pennsylvania; patented July 7, 1846; improvement added December 11, 1847; re-issued October 1, 1850.

Claim.—"What we claim as our invention, is the method of making the shank for door knobs in two pieces, coupled together near the middle by a notched connexion, and held together by means of the escutcheon at one end, and the latch bolt, (or by the tumbler that operates a latch bolt,) at the other, substantially as herein described.

"We also claim the constructing the keeper, and the lever fastener, of such shape and proportions that the keeper can be reversed in its position upon the latch plate: and the lever fastener be reversed in its position in relation to the keeper, for the purpose of adapting our improved lock or latch to doors opening either to the right or to the left, substantially as herein set forth.

"We also claim the connecting the respective shanks of the knobs to each other and to the lock or latch, by means of the tooth in the halved portion of one shank fitting into an aperture in the halved portion of the other, and the two being confined to each other by the tumbler, the tube, projecting from the side of the lock or latch, and the escutcheon, secured to the door, substantially in the manner herein set forth."

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2. For an *Improvement in Mills for Grinding Bark;* Sidney A. Bantz and William Andrews, Frederick, Frederick county, Maryland; patent December 4, 1849; re-issued October 15, 1850.

"Our invention consists, 1st, in giving a vibratory motion to the concave, so that it shall diverge from, and close towards, the cylinder, whereby a drawing motion is communicated to the teeth which thus cut as well as crush the bark; 2d, in the peculiar form given to the teeth of the concave, which increases their strength and enables them to act more effectually on the bark."

Claim.—"What we claim therein as our invention, is the vibratory motion given to the concave, substantially in the manner herein set forth."

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3. For an *Improvement in Portable Furnaces;* Merritt F. Potter, Charlemont, Massachusetts; patented January 22, 1850; re-issued October 22, 1850.

Claim.—"I claim as my invention, the construction of a portable furnace, by which it may be connected with a stove in the manner described: that is, a furnace adapted to the boiler, or other hole of a stove, with a downward draft or diving flue for the escape of the smoke through the bottom into the stove, substantially in the manner and for the purposes set forth."

Designs.

1. For a *Design for Stoves;* Anthony W. Jones, City of New York, assignor to Edward R. Brown, Albany, New York, October 1.

Claim.—"What I claim as my production, is the combination and arrangement of ornamental figures and forms represented in the accompanying drawings, forming together an ornamental design for a parlor stove."

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2. For a *Design for Grate Frame and Fender;* James L. Jackson, City of New York, October 15.

Claim.—"What I claim as my production herein, is the combination and general arrangement of the figures and ornaments as set forth and shown in the drawings herein described, for forming an ornamental grate frame, summer piece and fender, substantially as described."

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3. For *Design for Stoves;* Ezra Ripley, Troy, New York, assignor to George W. Eddy, Waterford, New York, October 22.

Claim.—"What I claim as new, is the design of ornament, shape, and configuration of parlor stove plates, as described and represented in the annexed drawings."

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4. For a *Design for Stoves;* Ezra Ripley, Troy, New York, assignor to George W. Eddy, Waterford, New York, October 22.

Claim.—"What I claim, is the design and configuration of ornamented parlor stove plates, substantially the same as described and represented."

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5. For a *Design for Stoves;* Laban Eddy, Taunton, Massachusetts, October 29.

Claim.—"What I claim as my invention, is the ornamental composition of each foot.

"I also claim the ornamental composition of either the base, the cornice, or the blockings, as well as a combination of the whole of the same.

"I also claim the ornamental composition or design for the main oven door, as well as that of either of the small doors."

6. For a *Design for Iron Railings;* William Ballard, City of New York, October 29.

Claim.—"What I claim is the particular ornamental design or device for a railing and gate posts, as herein combined and specified: that is, the posts, panel and marginal grape vine base in form and design, substantially as herein set forth."

NOVEMBER.

1. For an *Improvement in Machines for Dressing Irregular Forms;* Alanson Cary, Worcester, Massachusetts, November 5.

"The nature of my invention consists in a horizontal bench, in or near the centre of which is a circular table, which is fitted in such a manner to the bench as to be capable of receiving a circular motion; the table carries two slides, placed at right angles, one above the other, the lower one capable of sliding in a line across the circular table, and the upper one sliding in rebates or guides in the lower one at right angles to the direction in which the lower one itself slides; the work to be operated upon is secured by dogs to a plate above the top slide, and by the means hereinafter described, receives such a motion that a fixed point will mark the required pattern on the work; a rotary cutter is suspended on a swinging arm above the work; this is capable of being adjusted to take a cut of the required thickness, and while motion is given to the work in the required direction, it will cut it to the required form."

Claim.—"I claim the toothed wheel upon the shaft, arranged so that it is capable of being thrown in gear with either of the racks, in combination with the dog on the slide and the notched projection on the table, by which the slide is locked to or unlocked from the table for the purpose of enabling the wheel to give either a rectilinear motion to the said slide, or a circular motion to the table, as may be required, in the manner and for the purposes substantially as herein set forth."

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2. For an *Improvement in Rotary Pumps;* William H. Davis, Maysville, Mason county, Kentucky, November 5.

Claim.—"What I claim as new, is the two pistons acting alternately with each other as rotary pistons, and as stationary partitions, in connexion with the arms and apparatus by which they are worked, substantially as above set forth."

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3. For an *Improvement in Furnaces for Steam Boilers;* F. P. Dimpfel, Philadelphia, Pennsylvania, November 5.

"The nature of the first part of my invention consists in making a hollow or box lining, with a partial partition or partitions interposed between the outer shell and inner lining, so that the air, whether introduced under pressure or by draft, shall rise between the outer shell and the partition or partitions, and then over the upper edge thereof, and then down and through the inner lining to the fuel contained therein.

"And the second part of my invention consists in making the furnace door with an inner plate or lining, separated therefrom, so as to leave an open space for the passage of a cooling medium, such as cold air, steam, or water; the said door so constructed being combined with a tube or tubes, or apertures for the passage of the said cooling medium."

Claim.—"What I claim as my invention, is the method substantially as described of making the box lining of furnaces, with a partition or division plate or plates between the inner lining and outer shell, to direct the current or currents of air before entering the fire, substantially for the purpose and in the manner specified.

"I also claim the manner of arranging the furnace door with its interior plate or lining, in combination with the tube or apertures for blowing or forcing in air, steam, or other cooling medium, between the door and said plate, all as herein described, irrespective of form; and also of the manner of producing the forced current of the cooling medium."

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4. For an *Improvement in Washing Machines;* Richard A. Fisher, Sunbury, Northumberland county, Pennsylvania, November 5.

Claim.—"What I claim as my invention, is the arrangement of three vertical pressers or washers, in combination with the fan, arranged and operated in the manner and for the purposes above set forth."

5. For *Improved Valves for Governers;* Junius Judson and Alfred Judson, Rochester, Monroe county, New York, assignors to Junius Judson, Rochester, New York, November 5.

[At the request of the patentee, the description of this invention is postponed for the present.]

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6. For an *Improvement in Straw Cutters;* A. S. Macomber, Bennington, Bennington county, Vermont, November 5.

"The nature of my invention consists in dispensing with the ordinary feeding rollers, and using rotary spiral cutters, in combination with a stationary knife, placed across the mouth of the straw cutter, one rotary cutter being placed above the edge of the knife and another below it; the edges of the rotary cutter come in contact with the edge of the stationary knife, and produce a cutting effect nearly similar to that of a pair of shears, the rotary cutters feeding themselves and leading the straw."

Claim.—"What I claim as new in my invention, is the application and use of rotary spiral cutters, which are self-feeding, in combination with a stationary knife, or cutting edge, in the manner and for the purpose substantially as described."

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7. For an *Improvement in Lime Kilns;* William McCoy, Fannettsburgh, Franklin county, Pennsylvania, November 5.

Claim.—"What I claim therein as new, is, 1st, the construction of an upper tier or tiers of arches, in the manner and for the purpose herein fully set forth.

"2d, I claim the recesses or openings, in combination with an upper tier or tiers of arches for the purpose of creating a draft through the structure after the lower arches have become stopped up."

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8. For an *Improvement in the Running-gear of Carriages;* Joseph Pine, City of New York, assignor to Benjamin Pine, City of New York, November 5.

"The nature of my invention consists in providing the pole of the carriage with an interior rack on its inner end, meshing into a central cog-wheel, which operates the axles on the front wheels, each of which has a rack on its inner end; also, in combining the front central cog-wheel with the hind central cog-wheel by diagonal braces, which operate the axles of the hind wheels in unison with the motion of the front wheels, the whole being operated by the pole of the carriage to move the wheels to the requisite angles for turning the corners of streets abruptly, and also for preventing the wheels from being turned out of their course, unless operated by the pole of the carriage."

Claim.—"I do not claim a separate axle for each wheel, neither do I claim the diagonal braces for uniting the front or back axles, as these have been known before; but what I do claim, is the axles of the wheels having racks on their inner ends meshing into central cog-wheels, the front one of which meshes into a segmental rack on the inner end of the pole of the carriage, the whole being constructed, arranged, and operating in the manner substantially as described."

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9. For an *Improvement in Operating the Copping Rail of Cop-spinners;* Wanton Rouse, Taunton, Bristol county, Massachusetts, November 5.

"The nature of my invention consists in a new and improved mode of operating and changing the speed of the upward and downward motions of the ring rail for governing the winding of the thread in forming the cops."

Claim.—"What I claim as new in my invention, is changing the direction in which the ring rail is moved, and the speed at which it is operated, for the purpose of governing the winding of the thread on the cop, and forming a bind thread, by means of the combination of the shaft, M, having a toothed wheel, N, and smaller wheel, O, fast upon its axis, with the shaft R, having on it a fast toothed wheel, S, and a loose smaller wheel or pinion, V, operated by shifting belts and pulleys, or other similar changing or reversing gear."

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10. For an *Improvement in Hardening Fats and Oils;* Carl W. Schindler, City of New York, November 5.

"The nature of my invention consists in imparting to every kind of fat and oil without

separating the stearine from the oleine, such a degree of hardness that it can withstand a heat of at least 135 degrees Fahrenheit without melting, even in water heated to that degree."

Claim.—"What I claim as my invention, is the hardening of fatty or oily substances without separating the stearine from the oleine to such a degree that they can withstand a heat of at least 135 degrees Fahrenheit without melting; using for that purpose the ingredients of cera japonica and gum elemi, in the manner and proportions above described, which will produce the intended effect."

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11. For an *Improvement in Clamps for Girding Emery Wheels;* Henry S. Vrooman, Springfield, Hampden county, Massachusetts, November 5.

Claim.—"What I claim as my invention, is the combination of the screws, and toggle-joint, with the jaws, substantially as herein described and set forth, for the purpose of producing, 1st, tension of the girding substance, and then the compound motion of the jaws, in closing together and settling down to the object on which the machine rests."

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12. For an *Improved mode of Fastening Hooks and Eyes upon Cards;* Ezra J. Warner, Waterbury, New Haven county, Connecticut, November 5.

Claim.—"What I claim as my invention, is the putting on of the hooks and eyes in such a manner upon paper, perforated as herein described, that the points of the hooks are upon one side of the sheet, and the eyes upon the other side, thereby securing the eyes against dropping off from the hooks. I claim nothing in regard to the manner of perforating or folding the paper."

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13. For an *Improvement in Fly-Brushes;* Samuel R. Wilmot, Lafayette, Tippecanoe county, Indiana, November 5.

Claim.—"What I claim as new, is so constructing and adapting the revolving fan or brush, that it may be placed like a lamp upon a table, or may be fixed to the walls or ceiling of a room, or that it may be suspended by a cord over a bed, sofa, or cradle, by the means herein fully described."

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14. For an *Improvement in Apparatus for Stretching and Smoothing Cloth;* John Butcher, Lowell, Middlesex county, Massachusetts, November 5.

Claim.—"What I claim as my invention, is the combination of the revolving platform or table, and the guide roller or apparatus, with the series of stretching rollers; the whole being substantially in the manner and for the purposes as herein before specified."

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15. For an *Improvement in Portable Furnaces;* John P. Hayes, Boston, Massachusetts, November 5.

Claim.—"What I claim as my invention, is a summer furnace in which the draft is derived to the fire chamber from the exterior of the furnace, and at the bottom of the same, and passes first up through a flue chamber, (formed between the partition *i i* and the periphery of the furnace as above set forth,) and then down through the fuel, all as herein above set forth, and for the purpose specified."

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16. For an *Improvement in Processes for Curing Meat;* George Starkweather, Hartford, Connecticut, November 5.

"My invention consists in subjecting the meat in brine to the joint action of atmospheric pressure and agitation; this is effected by introducing the meat and brine into a turning vessel within which the pressure of the atmosphere is alternately removed by an exhaust pump, and re-applied as often as may be necessary to effect the curing of the meat.

Claim.—"I make no claim to the curing of meat by mere agitation in brine; nor to the saturation of meat with brine by alternately withdrawing and re-applying the pressure of the atmosphere, without at the same time agitating the meat; but, what I do claim as my invention, is the method of curing meat by placing it with brine, within a vessel, and then subjecting it to the combined action of agitation, and an alternate increase and diminution of atmospheric pressure substantially as herein set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

Reply to the Objections of "M." (Published in the October Number, page 260,) to a Comparison Between the Radial and Perpendicular Paddle Wheels for Steamers. *By* B. F. Isherwood, *Chief Engineer U. S. N.*

The main objections are the dissimilarity of the experimental vessels and the manner in which the calculations are made. They are easily answered. The vessels were selected, though differing much in size, because their performances had been accurately ascertained by trial at a "measured mile" up and down on the Thames river; that is, their speeds, number of revolutions of the wheels, dip of paddles, and all other necessary data had been exactly observed, with the single exception of the steam pressure in the cylinder; and no other data in my possession on vessels approximating each other more nearly in size had this exactness. Now it is perfectly well known to all engineers, that with the usual speeds of piston and areas of steam passages, that with wide throttles, the initial steam pressure in the cylinder can be very nearly deduced from the boiler pressure, being from 1½ to 2½ pounds less, or a mean of 2 pounds, and this has been the unvarying result as shown by a great number of indicator cards taken from various English and American steamers; indeed, after an inspection of many, I cannot recollect having seen one, in which the variation from the boiler pressure did not lie between the above limits. In my calculations, the horses power was deduced from the boiler pressure minus 2 pounds, the back pressure in the cylinder being taken at 4 pounds, which has been shown by many indicator cards to be a mean; the expansion was calculated by hyperbolic logs, the point of cutting off having been given. I am therefore warranted in believing the powers to be very near the truth. Supposing, however, that the initial pressure in the cylinder could not be reliably deduced from the boiler pressure, yet as the same steam pressure was carried in the boilers of each engine, and as the speeds of the pistons compared as 1·00 and 1·03—the steam passages being of usual proportions, there is every reason to presume the variation of the cylinder from the boiler pressure would be the same in each case, consequently no error in the comparison would flow from this.

It is also objected that "*the most important circumstance of all, viz., the consumption of fuel, is entirely neglected.*" Now, the only possible connexion which the consumption of fuel can have with the question, is as the measure of the powers of the engines, and of all measures of the powers of steam engines, the consumption of fuel is the most uncertain; indeed, so widely differing from the truth, that when no other measure can be obtained, comparisons are wholly impossible, and for the following among many reasons. It has been ascertained from the carefully made experiments of Smeaton, that the evaporating power of the different kinds of coal in use in England varies from 86 to 133; further, that with the same coal, burned on the same grate beneath the same boiler,

the difference between the results obtained from a well managed fire, is $\frac{1}{8}$th greater than from an ill managed one, where the coal is filled in too thick or unevenly, or is too seldom or too much stirred. If, in addition to these, we add that the evaporation obtained from a given weight of fuel depends altogether on the proportions and type of boiler as well as on the incrusations that may cover its fire surface, it will be perceived as has been judiciously remarked by Pambour, that "*with respect especially to the effects attributable to the consumption of a given weight of fuel, nothing can be more uncertain.*" Indeed, these effects often range from 43 to 100 for the same weight of fuel.

I have already given the reasons which determined the selection of the experimental vessels, but "M." objects to the manner in which I have calculated their coefficients of resistance, without having the remotest idea of that manner; for he represents, or rather misrepresents me as making that calculation in the following absurd manner, viz:—

"He assumes the hull resistances to be in the ratio of the squares of their midship sections divided by their displacements."

Now, no such assumption is anywhere made by me, and in reply to this objection I need only quote what I did assume, viz.:—

"The vessels are, however, of different dimensions, and the power required to propel them at equal speed will be as their resistances multiplied by their respective immersed amidship sections. These resistances will be in the compound ratio of their immersed amidship sections and displacements."

And again:

"The coefficients of resistance for the hulls will be obtained as follows: The vessels having about the same proportions between length and beam, their resistances (that is the relative resistances of their models) may be considered as their displacements and immersed sections."

The meaning of the above quotations is, I believe, pretty clear. The hypothesis assumes the resistance of the hulls to be in proportion to their immersed amidship sections multiplied by a coefficient representing the fineness of the water lines. Now it is evident, that of the immersed part of two hulls, the hull having the less displacement (true displacement, not custom-house tonnage) proportionally to its greatest immersed section, will have the finest water lines, and consequently the compound ratio of the sections and displacements of two hulls of nearly similar proportions between the length, breadth, and depth of their immersed portions (not length, breadth, and depth measured from the deck, which "M" objects to in the vessels of my data for wanting similarity, as though those elements entered at all into the calculation,) will give comparatively the resistances in function of model. To quote again from my previous article:

"To obtain the absolute resistances of the vessels, the above resistances in function of model must be multiplied by their respective amidship sections. This product represents relatively the proportions of power required to propel the vessels at equal speed."

The coefficients of resistance obtained by this method of calculating are a very close approximation to the truth, and I have often verified the accuracy of the method from reliable data on steamships propelled with the common radial paddle wheel, which, as it allows the disposition of power to be wholly accounted for, permits the hull's coefficient of resistance to be ascertained. In the comparison between the "Black

"Eagle" and "Trident," these coefficients could not be thus determined, because the friction of the eccentric strap and of the jointed levers of the "Black Eagle's" wheel was an unknown quantity to be determined by the coefficient of the hull obtained in another manner. And this brings me to the second main objection of "M," which is to my method of calculation, and is expressed as follows:

"It will be observed that in his calculation of powers, Mr. I., instead of deducting only the slip, and the power required to work the air-pumps, &c., thus leaving the whole available powers of the engines to be compared with each other, and with the effects produced, (the friction being of course proportional to the load,) has deducted also the (calculated) elements of oblique action in one wheel, and reaction in the other, which being precisely the causes of economical difference between the two kinds of wheel, are precisely those which should have been left to be determined by the results of the comparison; so that in fact the only thing really proved by that comparison as made by him, is that either his powers or his effects are erroneously calculated.

"If this be not the case, where does the difference go? To what is owing the ratio of 1·0000 to 0·9055? The author first calculates the respectively disputed elements—deducts them from his powers, thus reducing the wheels to an equality in effect; and then, because the powers so obtained do not correspond with the resistances he has calculated, we are told the difference is owing to the respective values of the two wheels."

The whole of the above quotation is a misapprehension. In the first place, the losses by the oblique action of the radial paddle, and by the reaction of the perpendicular paddle are not by any means "*the causes of economical difference between them.*" With the perpendicular paddle wheel, provided a slip normal to the immersion of the paddle be given, there will be no loss at all by reaction:—a reactionary loss is not a necessary consequence of employing a perpendicular paddle wheel and never obtains in a well proportioned one. The "causes of economical difference" are slip plus oblique action with the radial paddle wheel, and slip plus the *friction of the eccentric strap and jointed friction levers* in the perpendicular paddle wheel, to which must be added, when it obtains by employing injudicious proportions, the reactionary loss. "M." also says, that when the losses by slip, and the power required to work the air pumps have been deducted, the remainders are the available powers to be compared. Now it is at once evident that the available powers, that is, the powers available to propel the vessels; will be those remaining after deduction has been made for slips, oblique action, reactionary losses, and all kinds of friction, both of the load and the engine, and the gearing of the perpendicular paddle wheel. These remainders would be the true available powers, and supposing the relative resistances of the vessels to be accurately obtained for equality of speed, it is evident these remainders should have the same relation to each other as the resistances of their respective vessels. Now in the calculations on the "Black Eagle" and "Trident," there was calculated for the "Trident" ALL the losses due to the friction of the load, to the engine, and to the radial paddle wheel; and for the "Black Eagle" there was calculated *all* the losses due to the friction of the load, to the engine, and to the perpendicular paddle wheel, EXCEPT that due to the *friction of the eccentric strap and jointed levers* of the perpendicular paddle wheel. The remainder of available power belonging to the "Black Eagle" would then be *too much* by the amount due to this friction; there would therefore *not* be an equality between the remainders, (proportional to the re-

sistances,) and the difference between the remainder as obtained, and as it should be to have this equality, will be the measure of the power absorbed in the friction of the eccentric strap, jointed levers, &c.; but, indeed, the whole of this is so clear in the original article, that the best reply to "M.'s" objections is to quote its language as follows:—

"The calculations we are about to make, have for their object the determination of the friction of the lever journals, and of the eccentric strap of the perpendicular paddle, in per cents. of the total power developed by the engine. To effect this, there must be calculated for the two vessels the losses (omitting the friction loss by the perpendicular paddle wheel) by their respective paddle wheels, viz: in the 'Black Eagle' by slip and reaction, and in the 'Trident' by slip and oblique action. To these must be farther added the power, in per cents., which has been found in practice required to work the engine, and to overcome the friction of load. The remainder of the power will be considered as that utilized in the propulsion of the vessel. The vessels, however, are of different dimensions, and the power required to propel them at equal speed will be as their resistances multiplied by their respective immersed amidship sections. These resistances will be in the compound ratio of their immersed amidship sections and displacements. The previous remainder of the power being multiplied by these coefficients of resistance inversely, will represent the powers proportionally to the resistances they overcome. The final comparison is now readily made, by taking these proportional powers as the measure of the powers, and the cubes of the speeds of the vessels as the measure of the effects.

"If now our data were exactly correct, and there were no loss of labor by the friction of the perpendicular paddle wheel, the final comparison would show, in each case, the powers to bear equal proportions to the cubes of their respective speeds; assuming the data to be correct, there will remain the loss by friction of the perpendicular wheel included in the final comparison, which will then not show the powers to bear equal proportions to the cubes of the speeds, and the discrepency is the measure of the power absorbed in the friction of the perpendicular paddle wheel."

The calculations being made, the final comparison stood as follows:

	"Black Eagle."	"Trident,"
Powers, ...	1·0000	0·8245
Effects, ...	1·0000	0·7466

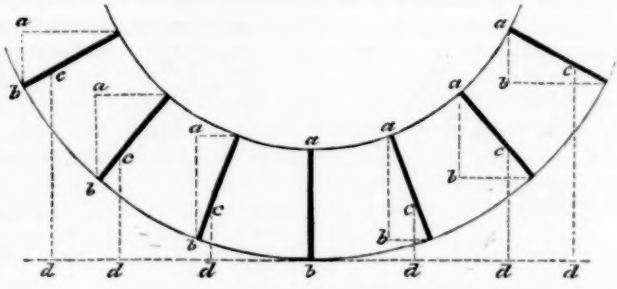
And 8245 : 7466 :: 1·0000 : 0·9055.

"That is to say, the result of the applicatian of the power in the 'Black Eagle' is better in the proportion of 1·0000 to 0·9055 than in the 'Trident,' according to the calculation, and the calculation includes as utilized power in the 'Black Eagle,' the power necessarily absorbed by the friction of its perpendicular paddle wheel. But as allowance for the different resistances of the hulls has been made, the discrepency in the calculation is produced by, and is equal to, the power absorbed in this friction, and this discrepency is 1·0000—0·9055=0·0945, and 0·0945 is 9·45 per cent. of the total power 1·0000 of the 'Black Eagle,' 9·45 per cent. of the total power is therefore the loss by friction of the perpendicular paddle wheel of the 'Black Eagle.'"

"M." will probably now understand "to what is owing the ratio of 1·0000 to 9·9055," and why "because the powers so obtained do not correspond with the resistances I have calculated, we are told that the difference is owing to the respective values of the wheels," whereas, in fact, he is only told that the difference is owing to the friction of the eccentric strap and jointed levers of the perpendicular paddle wheel.

"M." has also adopted several errors with regard to paddle wheels, especially that which relates to the cycloidal action of the paddle through the water. People have confused themselves after tracing the cycloidal path of the paddle by considering it as relative to its action on the *water*, when it is in truth only relative to the *motion of the vessel*. The action of the paddle on the water when the vessel is in motion, is precisely the same as when the vessel is at rest, as far as the oblique action of the

radical paddle is concerned; and furthermore, in direct opposition to "M," the radical paddle, when in vertical position, is the most effective for propelling purposes, all of which is clear from the following reasons:



The propelling efficiency of any paddle is as its projected surface *a b*, in the direction of the keel of the vessel, multiplied by the square of its velocity (that is by the square of its *horizontal* velocity) in the *same direction*. By referring to the diagram it will be seen that when the paddle is vertical, it gives the greatest projection in the direction of the keel, and that that projection diminishes as we recede from the vertical position. Furthermore, the horizontal speeds of the different paddles will be obtained relatively by dropping from the centre of reaction of each paddle, perpendiculars *c d*, on a horizontal line; the spaces *d d* will represent comparatively the horizontal speeds of the paddles. Hence to give equal slips, the total amount of projected propelling surface in the perpendicular paddles must be made equal to the total amount of projected surface with the radial paddles; but when a small wheel (compared to its vessel) is used, it must have a deep immersion to obtain sufficient propelling surface, and if the wheel have radial paddles, this deep immersion will operate an enormous loss by the oblique action of the paddles, to avoid this loss the wheel must be made larger so as to give the same immersed paddle surface with less immersion of the wheel. From this it obviously follows that the perpendicular paddle wheel operating with simply the losses from its slips and the friction of the gearing of the wheel, for it need have no reactionary losses; and having no loss from oblique action, can be immersed to a greater depth than the radial paddle wheel, and consequently a wheel of less diameter will have equal propelling efficiency; beside, each paddle giving a maximum projection in the direction of the keel, there is no surface lost by the obliquity of the radial paddle, from this results a further reduction in the length of the paddle.

I shall only notice one more of "M.'s" errors, and that only as a specimen of his reasoning. He says, that upon the trial of two equal and in all respects similar steamers, except in kind of wheel, one being propelled with the common radial paddle, and the other with the per-

pendicular paddle, that in order to attain equal speeds, the perpendicular paddle wheel had to make two more revolutions per minute, "*of course involving a greater consumption of fuel.*" Now with the same diameter from outside to outside of paddles, the diameter of the circle of the centre of reaction will be less with the perpendicular than with the radial paddle, the relative proportions of the breadths of the two paddles being about as $2\frac{1}{2}$ to $4\frac{1}{2}$. Now the leverage of the paddles on the same engine will be as the radii of their respective circles of the centre of reaction, consequently the load upon the engine with the perpendicular paddle wheel will be less, revolution for revolution, than with the radial paddle wheel, and if the load be less, there will be required less steam to move it; so it is easily perceived that the "of course" involves a *less* instead of an *equal* consumption of fuel, revolution for revolution. The diameter of the circle of the centre of reaction of the perpendicular paddle wheel being less than that of the radial paddle wheel, there will, "of course," be required more revolutions of it to go a given distance, but there will also be a proportionally less power required to make a revolution, in the same manner that a small wheel must turn oftener than a large one in traversing the same road, but I believe "M." is the first discoverer that it "of course" involves a greater expenditure of power, and I leave him to the credit of his discovery, reaffirming the truth of the theory, data, and calculations of my original article on the two kinds of wheels.

With regard to the trial quoted by "M." as made with the two kinds of wheels at Maudslay & Field's works, it was made without any sagacity of method, and both the experiment in its conduct and the conclusions drawn from it, are erroneous, and could easily be so proven had I not already exceeded the proper limits for this reply.

New York, November 9, 1850.

Note by the Editor.—We insert the reply of Mr. Isherwood to our correspondent "M.," omitting, however, and altering so much as was necessary to destroy the disagreeable personalities which Mr. I. has been pleased to introduce into the discussion. Our alterations have in no wise altered the sense or the strength of Mr. I.'s arguments and affirmations, which must, of course, go for what they are worth. He was entitled to reply, but our Journal cannot be made a vehicle for personal abuse.

On the Heat of the Vaporization of Water. By J. P. Joule.*

The object was to point out the complex nature of the heat hitherto taken from the latent heat of steam. In the exact experiments of Regnault 965° was found to be the quantity of heat evolved in the condensation of steam saturated at 212°; of this quantity, 75° is the heat due to the *vis viva* communicated by the pressure of the steam, leaving 890°

* From the London Civil Engineer and Architect's Journal, for November, 1849.

as the true heat of vaporization of water. In a perfect steam engine supplied with water at 212°, and worked at atmospheric pressure without expansion, 965° will be the heat communicated from the fire to the boiler, 75° will be the heat utilized by conversion into force, and the remainder, 890°, will be the heat given out in the condenser.—*Proc. Brit. Assoc., Sept.* 1849.

On Atlantic Waves, their Magnitude, Velocity, and Phenomena. By Dr. Scoresby.*

During *two* passages across the Atlantic in 1847–8, I had opportunities for investigating certain elements respecting deep sea waves more favorable than had ever before occurred within my experience in navigation. These observations, it should be noted in the outset, and the results deduced from them, were entirely uninfluenced by, and separate from theory. They form but a contribution to this interesting branch of natural phenomena; but I offer them the more readily from the circumstance of their entire independency and speciality. It was in our return voyage from America that the highest seas occurred, when the circumstances adapted for interesting observations were singularly favorable; for, whilst the magnitude and the peculiar construction of the upper works of the ship—the Hibernia—afforded various platforms of determinate elevation above the line of flotation for observations on the height of the waves, the direction of the ship's course, with respect to that of waves, was generally so nearly similar as to yield the most advantageous agreement or accordance for observations on their width and velocity. These observations I shall extract, in their order, from my Journal kept during the homeward passage. My first observation worth recording, is under the date of March 5, 1848, when the ship was in latitude about 51°, and longitude (at noon) 38° 50′ W.—the wind then being about W.S.W., and the ship's course, true, N. 52° E. At sunset of the 4th, the wind blew a *hard gale*, which, with heavy squalls, had continued during the night; so that all sail was taken in but storm-staysail forward. The barometer stood at 29·50 at 8 P.M., but fell so rapidly as to be at 28·30 by 10 the next morning. In the afternoon of this day, I stood some time on the saloon deck or cuddy roof,—a height, with the addition of that of the eye, of 23 feet 3 inches above the line of flotation of the ship—watching the sublime spectacle presented by the turbulent waters. I am not aware that I ever saw the sea more terribly magnificent. I was anxious to ascertain the height of these mighty waves; but found almost every wave rising so much above the level of the eye, as indicated by the intercepting of the horizon of the sea in the direction in which they approached us, as to yield only the *minimum* elevation, and to show that the great majority of these rolling masses of water possessed a height of considerably *more* than 24 feet, (including depression as well as altitude,) or, reckoning from the mean level of the sea, of *more* than 12 feet. Exposed as the situation was, I then adventured to the larboard paddle box, which was about 7 feet

* From the London Athenaeum, August, 1850.

higher, where the level (as ascertained afterwards at Liverpool, allowance being made for the alteration in the draft of water of the ship,) was 24 feet 9 inches above the sea. This position, with 5 feet 6 inches, the height of my eye, gave an elevation altogether of 30 feet 3 inches for the level of the view then obtained,—a level, it should be remarked, which was very satisfactorily maintained during the instants of observation, because of the whole of the ship's length being occupied within the clear "*trough* of the sea," and in an even and upright position, whilst the nearest approaching wave had its maximum altitude. Here, also, I found at least *one-half* of the waves which overtook and passed the ship were far above the level of my eye. Frequently I observed long *ranges* (not acuminated peaks) extending 100 yards, perhaps, on one or both sides of the ship,—the sea then coming nearly right aft,—which rose so high above the visible horizon, as to form an angle estimated at 2 to 3 degrees (say $2\frac{1}{2}^{\circ}$) when the distance of the wave summit was about 100 yards from the observer. This would add near 13 feet to the level of the eye. And this measure of elevation was by no means uncommon,—occurring, I should think, at least once in half a dozen waves. Sometimes peaks of crossing or crests of *breaking* seas would shoot upward at least 10 or 15 feet higher. The *average wave* was, I believe, fully equal to that of my sight on the paddle-box, or more,—that is, $\frac{30}{2}$=15 feet or upwards; and the *mean highest waves*, not including the broken or acuminated crests, about 43 feet above the level of the hollow occupied at the moment by the ship. Illuminated as the general expanse not unfrequently was by the transient sunbeam breaking through the heavy masses of the storm-cloud, and contrasting its silvery light with the prevalent gloom, yielding a wild and partial glare, the mighty hills of waters rolling and foaming as they pursued us, whilst the gallant and buoyant ship—a charming "sea-boat"—rose abaft as by intelligent anticipation of their attack, as she scudded along, so that their irresistible strength and fierce momemtum were harmlessly spent beneath her and on her outward sides,—the storm, falling fiercely on the scanty and almost denuded spars and steam chimney raised aloft, still indicated its vast, but as to us innoxious, power, in deafening roarings,—altogether presented as grand a storm-scene as I ever witnessed, and a magnificent example of "the works of the Lord," specially exhibited to sea-going men, "and his wonders in the deep." In the afternoon of the same day, the gale again increased, blowing, especially during the continuance of a much protracted hail-shower, terrifically—roaring like thunder, whilst we scudded before it, causing the ship to vibrate as by a sympathetic tremor, and the tops of rolling waves, too tardy, rapid as was their actual progress, for the speed of the assailing influence, to be carried off and borne along on the ærial wings in a perfect drift of spray! But during the period of these most vehement operations of nature, I was fortunately enabled, from familiarity with sea enterprise, to pursue my observations with entire satisfaction. The next day, March 6, added to the interest of these investigations by developing the character of the Atlantic waves under a long and fiercely continued influence of a little varying wind. It had blown a heavy gale, violent in the showers, from the north-westward, from Saturday evening the 4th, to the evening of Sunday, from 26 to 30 hours; during the night, too,

of Sunday it had again blown hard (abating towards the morning of Monday), and making a total continuance of the storm, in *its violence*, of about 36 hours.* I renewed my observations on the waves at 10 A. M., the storm having been then subdued for several hours, and the height of the waves having perceptibly subsided. Soon I observed, when standing on the saloon-deck, that ten waves, in one case, came in succession, which all arose above the apparent horizon, consequently they must have been more than 23 feet, probably the *average* might be about 26 from ridge to hollow. At this period I also found that occasionally, (that is, once in about four or five minutes,) three or four waves in succession, as seen from the paddle-box, rose *above* the visible horizon, hence they must, like those of the preceding day, have been 30 feet waves. But one important *difference* should be noted, viz: that they were of no *great* extent on the ridge, presenting, though more than mere conical peaks, but a moderate elongation. Another subject of consideration and investigation, on this occasion, was the period of the regular waves overtaking the ship, and the determination, proximately, of the actual width or intervals, and their velocity. 1. The ship was then going *nine* knots only, the free action of the engines being greatly interfered with by the heavy sea running, and the lines of direction of the waves and the ship's course differed about 22½ degrees, the sea being two points on the larboard quarter,—in other words, the true course of the ship was east; the direction *from* whence the sea came was W.N.W. 2. The period of regular waves, in incidental series, overtaking the ship were observed as follows:—

Waves.		Min.	Sec.	Mean.
20	occupied	5	30	16″·5
10	"	2	35	15 ·5
10	"	2	50	17 ·0
10	"	2	45	16 ·5
8	"	2	16	17 ·0
General Average,		. . .		16 ·5

3. The length of the ship was stated to be 220 feet. The time taken by a regular wave to pass from stern to stem appeared, on a mean of several observations, to be about six seconds. Hence 6″ : 220 feet (the width passed over in that time) :: 16·5 feet to 605 feet (the width passed over betwixt crest and crest.) But this extent, by reason of the obliquity of the direction of the waves to the course of the ship, is found to be elongated about 45 feet, reducing the probable mean distance of the waves to 559 feet. Independently of this process, I had previously estimated the distance of the wave crests, ahead and astern when the ship was in the hollow, as I stood near the centre of the ship's length on the paddle-box, at 300 feet each way, by comparing the intervals betwixt my position and the place of the wave crest, with the known length of the ship. This comparison frequently reconsidered and repeated, subsequently yielded, in much accordance with the former, a total width, in the line of the ship's course, of about 600 feet. 4. But the total distance betwixt the

* The barometer on Saturday, at 8 P. M., was at 29·50; at 6 A. M. of Sunday it had fallen to 28·30, being 1·2 inches in 10 hours. At 6 P. M. of the latter day, it had risen to 30·00 inches.

crests of two waves, then reckoned at 550 feet, a distance passed by the wave in 16·5 seconds of time, by no means indicates, it is obvious, the real velocity of the wave, as the ship meanwhile was advancing nearly in the same direction at the rate of nine knots, that is nine geographical miles, or (6,075·6 feet × 9 =) 54,680·4 feet per hour, or 15·2 feet per second. During the time, therefore, of a wave passing the ship = 16·5″, the ship would have advanced on its course 16·5 × 15·2 = 250·6 feet. Reducing this for the obliquity of two points we have 231·5 feet to be added to the former measure, 559 feet, which gives 790·5 feet for the actual distance traversed by the wave in 16·5 seconds of time, being at the rate of $\left(\frac{3{,}600'' \times 790{\cdot}5}{16{\cdot}5} =\right)$ 17,251·7 feet, or 32·67 English statute miles per hour. To know how far this result is but proximate, it should be considered that, of the several elements employed in the calculation, all but one might be deemed accurate. The interval of time occupied by the transit of a wave with respect to the position of the ship, the *direction* of the ship's motion with relation to that of the waves, and the speed of the ship through the water, may all be recorded as, essentially, accurate. The element in doubt is that of the average distance from summit to summit of the waves. This distance, it has been seen, was, by a two-fold process of observation or comparison accordantly assumed. The value of the judgment derived from rapid comparison of measures by an eye accustomed to such estimations is, it should be observed, far higher than might be generally considered. The practical military commander or engineer officer is able to make, by mere inspection of the ground before him, remarkably close estimates of spaces and distances. When engaged in the Arctic whale fishery, I was enabled, from habit and comparison of unmeasured spaces with known magnitudes, to estimate certain distances with all but perfect accuracy. Thus as to a circumstance in which we were most deeply interested—the near approach of a boat to a whale, I found it quite practicable, whenever the pursuing boat approached within twice or thrice its length (except when the position was near end on) to estimate the distance to less than a yard. Now, the means of comparison by the eye as to the estimation of the breadth of the Atlantic waves, was that of the ship's length of 220 feet. When the ship was fairly in the middle of the depression betwixt two waves it was assumed, with reference to this known measure, that something obviously less, but not greatly so, than the ship's length, was the distance of each of the two waves then contemplated—giving a total width of about 600 feet. But the comparison of the time required by a wave to pass from stem to stern, with the average time of transit of an entire wave, yielded a much better result; and, on much consideration of the subject, I am inclined to believe that the estimate is a tolerably close approximation to the truth. It should be observed, too, that as the headway of the ship, in the direction of the course of the wave—being a known quantity—it was favorable to the accuracy of the estimate. For, assuming an error in the width of the waves to have occurred, say to the amount of one-twelfth of the whole, or 49 feet—the effect upon the calculated velocity of the wave would have been only about a sixteenth, or 2·16 miles per hour. The form and character of these deep sea-waves became at the same time interest-

ing subjects of observation and consideration. In respect to form, we have perpetual modifications and varieties, from the circumstance of the inequality of operation of the *power* by which the waves are formed. Were the wind perfectly uniform, in direction and force, and of sufficient continuance, we might have in wide and deep seas waves of perfectly regular formation. But no such equality in the wind ever exists. It is perpetually changing its direction within certain limits, and its force too, both in the same place and in proximate quarters. Innumerable disturbing influences are therefore in operation generating the varieties more or less observable in natural sea waves. In regard to my own observations of the actual forms of waves, nothing particularly new could be expected from an inquiry of this kind in regard to phenomena falling within the perpetual observation of sea-going persons; yet, at the risk of stating what might be deemed common, I will venture to transcribe from my notes made with the phenomena before me, the leading characteristics which engaged my attention. During the height of the gale (March 6th) the *form* of the waves was less regular than after the wind had, for some time, begun to subside. Though in many cases, when the sea was highest, the succession of the primary waves was perfectly distinct, it was rather difficult to trace an identical ridge for more than a quarter to a third of a mile. The grand elevation in such case sometimes extended by a straight ridge or was sometimes bent as of a crescent form, with the central mass of water higher than the rest, and, not unfrequently, with two or three semi-elliptical mounds in diminishing series, on either side of the highest peak. These principal waves, too, it should be noted, were not continuously regular, but had embodied in their general mass many minor, secondary, and inferior waves. Neither did the great waves go very prevalently in long parallel series like those retarded by shallow water on approaching the shore; but every now and then changed into a bent cuneiform crest with breaking acuminating peaks. On the following morning, (March 7,) after a second stormy night, wind S.S.W. (fine,) we had a heavy and somewhat cross sea (from the change of wind from W.S.W. to S.S.W.) But the almost unabated magnitude of the more westerly waves indicated a continuance of the original wind at some distance astern of us. The gale had moderated at daylight, and the weather became fine; but as the sea still kept high, its undulations became more obvious and easily analyzed. At three in the afternoon, when about a third part of the greater undulations averaged about 24 feet from crest to hollow, in height, these higher waves could be traced right and left as they approached the ship to the extent of a quarter of a mile on an average, more or less. Traced through their extent the ridge was an irregular roundbacked hill, precipitous often on the leeward side of waters. The undulations, indeed, as to primary waves, consisted mainly of these roundbacked masses, broken into or modified by innumerable secondary and smaller waves within their general body. The time in which these waves passed the ship was now, on an average, about 15 seconds, the ship's speed being increased from 9 to 11 knots, and the obliquity of the ship's course to the direction pursued by the waves was 3 points. On the 9th, two days after the above condition of the waves, whilst the sea yet ran high, few waves could be traced, continuously, above

300 or 400 yards in extent along the same ridge. The crests often curled over, but none so as to reach the height of a 30-feet wave, and broke for a wide space, estimated at 50 to 100 yards in continuity.

Miscellaneous Notes and Suggestions.—The mode adopted in these researches of finding the *height* of wave is, I believe, quite satisfactory, and, observed with care and with relation to numbers or proportion of waves, as accurate as need be. The depression of the horizon in respect to the elevation of the observer is too small to form even a correction. As the horizon from the paddle-box $\frac{30}{2} = 15$ feet, had only a depression of 3′ 49″, the distance of the visible horizon, as seen from this elevation, would be 4·45 statute miles, and the actual depression in feet due to the distance of the summit of the wave when the ship was in the midst of the hollow, could only be 0·18 feet or 2·16 inches. Other modes of determining the width of a wave—or the extent betwixt summit and summit—much preferable to that described (the only available one I could devise) might easily be adopted where the management of the ship was in the hands of the observer. In steam ships the simplest mode for high seas, perhaps, would be, altering the speed of the ship when going in the direction of the wave or against the wave; the ratios of the times of transit of wave-crests, under different rates of sailing of the ship might yield results very close to the truth. In moderate sized waves the plan adopted by Captain Stanley, whose observations I met with before this meeting, seem satisfactory. But in calms, or moderate weather after a storm—that is, for the determination of the velocities of less elevated waves, a variety of processes might be available.

The author referred, in conclusion, to the *forms* of wave crests, and heights, modified by crossings, interferences, and reflections.

Mr. Scott Russell felt a familiar interest in the results of these observations. The Section was aware that great doubts existed as to the actual heights of the waves of the open ocean. It was now past all doubt that waves 24 feet high, 30 feet high, 43 feet high, and with the swelling crest even exceeding 45 feet high, actually existed and were observed. From the observations which he had conducted many years since, he had ventured to draw up a table predicting the velocities of sea waves up to even 1000 feet from trough to crest in length. Although the apparatus which he had used did not enable him to experiment on waves which exceeded 16 inches in length, yet from these pigmy waves it was most interesting to see how accurately the law was obtained; for in his table the velocity of a wave whose length was 600 feet was set down at 30 or 31 miles per hour. Dr. Scoresby's actually observed velocity for this wave was 32 miles and a fraction.—*Proc. of Brit. Assoc.*

New Researches on the Conductibility of the Earth. By Professor MATTEUCCI.*

Although the good conducting power of the earth is at present generally admitted, and is advantageously applied to the construction of electrical telegraphs, it must be confessed that nothing has been hitherto

* From the London Athenæum, August 10, 1850.

known of the laws and theory of this singular phenomenon. In England, Germany, and Russia, it has been found advisable, for several years past, to form the telegraphic circuit partly with the earth and partly with a metallic wire, instead of forming the whole circuit with metallic wire only. I was, I believe, the first to show, by exact experiments, made in 1844 at Pisa, and by others performed according to my propositions at the Scientific Congress of Milan, that *the resistance of the earth* to the passage of the electrical current, which is sensible in short distances, ceases to increase and remains constant when the distance between the electrodes plunged in the earth has attained a certain length. Having latterly renewed my studies on this subject, I have confirmed and extended in a complete and general manner the conclusions drawn from my former researches; I have also demonstrated the principal result, given above, by different experimental processes. I have compared the resistance of a mixed telegraphic circuit with that of an entirely metallic circuit, containing a length of wire twice as great as that employed in a mixed circuit. I have also formed metallic circuits of very fine brass wires, having the same resistance as the metallic portion of a very long mixed telegraphic circuit; and finally, by making use of long metal wires covered with gutta percha, I have been able to compare the resistance of an entirely metallic circuit with that of a mixed circuit, in which the metallic portion remained constantly the same, and to which were added different lengths of earth. The following are the principal conclusions drawn from experiments which have occupied me for about a year. The resistance of a layer of earth to the passage of the electrical current varies according to the quantity of water contained in the earth of which it is composed,—according to the specific gravity of that earth,—according to its depth beneath the surface,—according to the nature of the electrodes and extent of their surface. This resistance does not increase with the increased length of the layer of earth; on the contrary, beyond a certain limit of length, which varies according to the different circumstances just indicated, but which in all cases is of little extent, the resistance of a layer of earth *remains constant* whatever be its length. It is unnecessary to say that I could not prove this fact by experiment on circuits exceeding eighty miles in length, such being the average of the telegraphic circuits in Tuscany. In making the experiment near the surface of the soil, it is difficult to plunge the electrodes in earth of exactly the same conducting power; different portions of the surface of soil possessing either better or worse conductibility than that on which I began to operate, it follows that in increasing the distance between the electrodes we may find either an increase or diminution in the resistance of the earth. Likewise, in operating on a long mixed telegraphic circuit, which is not perfectly isolated, owing to the effect of the different derived circuits formed between the posts and the earth, the electric current is stronger near the pile than at a distance, and stronger than in a circuit which is formed only of metal wire equal in length to that which enters into the mixed circuit. This explains the results which I had obtained from my former uncompleted experiments. The resistance of a layer of earth appears to diminish as its length increases only in cases where we meet with other layers of better conducting power. In every layer of

earth of a certain *constant* conducting power, the resistance, which at first increases very feebly with the increased length of the layer, becomes very soon constant, and continues the same for all the subsequent lengths, however great, on which experiments have been made. Now, it is evident that as the increase of resistance in a long metallic circuit is scarcely perceptible when we add to the circuit, by means of two large electrodes, a thin stratum of water; so we ought to find in the long mixed telegraphic circuits that the resistance of the earth is null or nearly so, since it is equal to that of a thin stratum of water of a very large section. The law of the conducting power of the earth being established, it remains to give the theory of this phenomenon. The opinion of the scientific world is divided on this point. Some explain the good conducting power of the earth by the almost infinite section of the earth compared with the distance of the electrodes; others, again, suppose that the electricities at the two extremities of the pile are dissipated in the earth, in the same manner as the electricity of the conductor of an electrical machine. This second explanation will not bear the slightest examination, nor can it be made to tally with the results of the most elementary experiments relative to the conducting power of the earth. In fact, we cannot on this supposition explain why the resistance of the earth increases at first with the length of the layer; why it varies with the depth and the degree of moisture of that layer; why it changes if the mass of earth interposed between the two electrodes happens to decrease or to be wanting, as I have proved by experiments made in mountainous districts; why the interposition of a portion of earth of a different conducting power produces a variation in the resistance of the entire mass; why this resistance becomes infinitely greater when we keep this layer in a wooden trough separate from the earth, but in communication with it by means of large metallic plates. Finally, according to this explanation, the resistance of the metallic part of a mixed circuit ought to disappear—a thing which never happens. I think that I may be able to give a satisfactory explanation of the good conducting power of the earth, founding my assertions on very simple experiments, and on theoretical views already known. As long ago as 1837, I proved in a memoir published in the *Annales de Physique et de Chimie*, that in operating on a certain liquid mass, very considerable compared with the distance of the electrodes plunged in it, *the length of the intermediate liquid stratum has no sensible influence on the intensity of the current.* I have recently verified this result on a very large scale. I had a wooden case made seven metres in the side. I keep this case isolated from the earth, and filled with water. Operating on this mass of water, we find that the resistance of a certain stratum of water, variable within certain limits, is independent of its length. In like manner, in studying the conducting power of spherical masses of water varying in diameter from $2^{c.m}$ to 30 or $40^{c.m}$, I have found that the resistance of these spherical masses of water was the same, and independent of their diameter. I have already said that this result may be deduced from the theory, and this is done as follows:—From the same differential equations, given first of all by Fourier in his celebrated theory of heat, and which Ohm has applied to electricity, suppressing in the latter case the terms which expressed

the dispersion of heat in the air, are deduced in the case of the sphere the results which I have obtained by experiments on the propagation of electricity in the earth. Although we are as yet ignorant of the physical value of that variable U which figures in the fundamental equation of Ohm at three partial differentials, which is the same as that of Fourier in the propagation of heat, and although that equation would really be more applicable to the case of the metallic wire which communicates at one extremity with the conductor of an electrical machine in action, and at the other extremity with the earth, than to the case of the electrical current defined by its electro-chemical and electro-magnetical action; it is no less true that a certain number of the phenomena of the electrical circuit are explained by representing the propagation of the electrical current by the same equation given by Fourier in his theory of heat.

Among these phenomena may be placed the fundamental law of the propagation of electricity in metallic wires according to their section and length, and the other more general cases of the propagation of the electrical current, and of derivation, in large metallic plates, or in spherical masses and in the earth, such as they have been found by MM. Kirchhoff and Smaaeen in Germany, and in Italy by my friends Ridolfi and Felici.

The reading of the communication from Prof. Matteucci led to a conversation on the various methods employed by the Electric Telegraph Company and others, and on the question of the investigations of Messrs. Bain and Wheatstone in England, and several experimentalists on the Continent prior to these investigations of M. Matteucci as to the power of the earth to conduct electricity—Mr. R. Hunt explained, that in speaking of the conductibility of the earth, it should be distinctly understood that the water contained in the superficial stratum is the conducting medium ;—since he has proved that non-metalliferous rocks and dry earth will not conduct an electric current.—*Ibid.*

On the Air and Water in Towns, and the Action of Porous Strata on Water and Organic Matter. By Dr. R. A. Smith.*

It is a matter of great importance to find from what source it is best to obtain water for large towns, and how it is to be collected. To these points Dr. Smith particularly directs attention. Regarding the conditions of many springs, which never become muddy, but possess a constant brilliancy and a very equal temperature at all seasons of the year, the author thinks that there is a purifying and cooling action going on beneath. The surface water from the same place, even if filtered, has not the same brilliancy; it has not the same freedom from organic matter, neither is it equally charged with carbonic acid or oxygen gas, there are other influences therefore at work. The rain which falls has not the purity, although it comes directly from the clouds; it may even be wanting in cleanness, as is often the case. Springs rise through a great extent of soil, and collect a considerable amount of inorganic salts; and it is shown by Dr. Smith that their purity is due entirely to the power of the soil to separate all organic matter, and at the same time to compel

* From the London Athenæum, August, 1850.

the mixture of carbonic acid and oxygen. The amount of organic matter removed in this way is surprising, and it is a most important and valuable property of the soil. The change even takes place close to cesspools and sewers; at a very short distance from the most offensive organic matter there may be found water having little or none in it. As an agent for purifying towns, this oxidation of organic matter is the most extraordinary, and we find the soil of towns which have been inhabited for centuries still possessing this remarkable power. St. Paul's Churchyard may be looked upon as one of the oldest parts in London, and the water from the wells around it is remarkably pure, and the drainage of the soil is such that there is very little of any salts of nitric acid in it. If the soil, says Dr. Smith, has such a power to decompose by oxidation, we want to know how it gets so much of its oxygen. We must, however, look to the air as the only source, and see how it can come from it. When water becomes deprived of oxygen, it very soon takes it up again, as may be proved by experiment. This shows us that as fast as the oxygen is consumed by the organic matter it receives a fresh portion, conveyed to it by the porous soil. Several experiments of the following character were given, to show the filtering power of the soil. A solution of peaty matter was made in ammonia; the solution was very dark, so that some color was perceived through a film of only the twentieth of an inch in thickness. This was filtered through sand, and came out perfectly clear and colorless. Organic matter dissolved in oil of vitriol was separated from it by a thickness of stratum of only four inches. A bottle of porter was by the same process deprived of nearly all its color. The material of which this filter is made is of little importance. One of the best, according to Dr. Smith, as far as clearing the water is concerned, being of steel filings,—oxide of iron, oxide of manganese, and powdered bricks all answering equally well. This shows that the separation of the organic matter is due to some peculiar attraction of the surfaces of the porous mass presented to the fluid. This paper was a continuation of Dr. Smith's Report published last year, and he purposes continuing the inquiry.—*Ibid.*

On the Incrustation which forms in the Boilers of Steam Engines, in a letter addressed to Dr. G. Wilson, F.R.S.E. *By* Dr. J. Davy.*

On entering on this inquiry, which I did after my return from the West Indies in December, 1848, and after communicating a short paper to the Royal Society "On Carbonate of Lime in Sea-water," it appeared to me desirable to collect as many specimens as possible of incrustation from the boilers of steam vessels, now so widely employed in home and distant navigation. By application to companies and to friends in our seaports, as Dundee, Hull, Southampton, Hayle, Liverpool, Whitehaven, I have succeeded in procuring specimens of incrustation formed by deposition in voyages from port to port, in the British and Irish Channels and the North Sea, between Southampton and Gibraltar, in the Mediterranean and the Black Sea, and in the Atlantic Ocean, between Liverpool and North America, and between Southampton and the West Indies. I am

* From the London Athenæum, for August, 1850.

promised specimens from the Red Sea and the Indian Ocean,—but these I have not yet received. The character and composition of the incrustation, whether formed from deposition from water of narrow seas or of the ocean, I have found very similar—with few exceptions, crystalline in structure, and, without any exception, composed chiefly of sulphate of lime; so much so, indeed, that unless chemically viewed, the other ingredients may be held to be of little moment, rarely amounting to five per cent. of the whole. From two specimens of incrustation from the boilers of steamers crossing the Atlantic, one of which you sent me, in which you had detected a notable portion of fluorine, judging from its etching effect on glass,—I also procured it, it was in combination with silica; and procured it also so combined from two obtained from steamers navigating our own seas, one between Dundee and London, the other between Whitehaven and Liverpool. Of this I had proof, by covering with a portion of glass or platina foil a leaden vessel charged with about 200 grains of the incrustation mixed with sulphuric acid, and by keeping the glass cool by evaporation of water from its surface, and by supplying moisture for the condensation of the silicated gas by a wet band round the mouth of the vessel. After about twenty-four hours under this process, a slight but distinct deposition was found to have taken place, corresponding to the margin of the vessel,—a deposition such as that produced by silicated fluoric acid gas under the same circumstances. Thus it was not dissipated by heat nor dissolved by water, and yet admitted of removal by abrasion, either entirely or in great part;—the former in the instance of the platina foil, the latter in that of the glass. Besides the ingredients above mentioned, I may add that, in many instances, oxide of iron, the black magnetic oxide, was found to form a part of this incrusting deposit, collected in one or more thin layers, and further, that in some, especially of steamers navigating the narrower and least clear part of the British Channel, the depositions presented a brownish discoloration produced by the admixture of a small quantity of muddy sediment. Incrustations so discolored, I may remark, are reported to be most difficult to detach. I have said that the incrustations, with few exceptions, were similar in their structure, and that that was crystalline;—it was not unlike the fibrous variety of gypsum of the mineralogists. The specimens received, as might have been expected, varied very much in thickness, viz., from one line and less to half an inch. I have endeavored, by a set of queries which I had distributed, to obtain information respecting the exact time in which the incrustations were formed, and under what circumstances; but with partial success only, owing, it may be inferred, to a want of exact observation. In one instance, that of the North American mail ship Europa, which arrived at Liverpool on the 15th of November, at 4 P. M., having left Boston on the 7th of the same month at 9 A. M., an incrustation was found in her boiler of about one-fiftieth of an inch in thickness; and it is stated that an incrustation of about the same thickness was found on her outward voyage. This example may aid in giving some idea of the degree of rapidity with which the incrustation is produced, at least in the Atlantic, with the precaution of "blowing off" every three hours, and with the "brine pumps" kept in constant work. In other seas, especially con-

tiguous to shores, and more especially of shores formed by volcanic eruptions, it is probable, *cæteris paribus*, the rate of the deposition of the incrusting sulphate of lime will be more rapid. The results of the trials of several portions of sea water taken up on the voyage from the West Indies to England noticed in the paper of mine already referred to, are in favor of this conclusion. To endeavor to prevent the deposition of the incrusting matter or to mitigate the evil, various methods, it would appear, have been had recourse to,—some of a chemical kind, as the addition of muriate of ammonia and sulphate of ammonia to the water in the boiler, without success, as might be expected; others, of a mechanical kind, with partial success, as the introduction of a certain quantity of sawdust into the boiler, or the application of tallow, or of a mixture of tallow and plumbago to its inside, to prevent close adhesion, and the more easy separation of the incrusting matter either by percussion, using a chisel-like hammer, or by contraction and unequal expansion, by means of flame kindled with oakum, after emptying the boiler and drying it. Of all the methods hitherto used, that of "blowing off," that is, the discharging by an inferior stop-cock a certain quantity of the concentrated water of the boiler by the pressure of steam, after the admission above of an equivalent quantity of sea water of ordinary density, appears to be, from the reports made, the most easy in practice, the least unsuccessful, and the most to be relied on. But, as in the instance given of the North American steamer, it can be viewed only as a palliation. Considering the composition of the incrusting matter and the properties of its principal ingredient—the sulphate of lime, a compound soluble in water and in sea water, and deposited only when the water containing it is concentrated to a certain degree, there appears to be no difficulty theoretically in naming a preventive. The certain preventive would be the substitution of distilled or rain water in the boiler for sea water. Of this we have proof in the efficacy of Hall's condenser, which returns the water used as steam, condensed, after having been so used: but, unfortunately for its practical success, the apparatus is described as being too complicated and expensive for common adoption. Further proof is afforded in the fact, that the boilers of steamers navigating lakes and rivers in the waters of which there is little or no sulphate of lime, month after month in continued use, remain free from incrustation. This I am assured is the case with the steamers that have been plying several summers successively on the lake of Windermere. And it may be inferred, that in sea-going steamers in which sea water is used in the boiler,—or, indeed, any water containing sulphate of lime, the prevention of deposition may be effected with no less certainty by keeping the water at that degree of dilution at which the sulphate of lime is not separated from the water in which dissolved. From the few trials I have made, I may remark, that sulphate of lime appears to be hardly less soluble, if at all less, in water saturated with common salt than in perfectly fresh water. This seems to be a fortunate circumstance in relation to the inquiry as to the means of prevention, and likely to simplify the problem. If these principles be sound, their application under different circumstances, with knowledge and judgment on the part of the directing engineer, will probably not be difficult. His great object will be in sea-going steamers to

economize the escape of water in the form of steam, and thereby also economize heat and fuel; also, when fresh water is available to use it as much as possible; and further, to avoid using sea water as much as possible near coasts and in parts of seas where sulphate of lime is most abundant. From the incrustation on the boilers of sea-going steamers, the attention can hardly fail to be directed to that which often forms, to their no small detriment, in the boilers of locomotive railway engines, and of engines employed in mines and in the multifarious works to which steam power is now applied. These incrustations will of necessity be very variable, both in quantity and quality, according to the kind of ingredients held in solution in the water used for generating the steam. Hitherto I have examined two specimens only of incrustations taken from the boilers of locomotive engines, and a single one only from the boiler of a steam engine employed on a mine—a mine in the west of Cornwall. The latter was fibrous, about half an inch thich, and consisted chiefly of sulphate of lime, with a little silica and peroxide of iron, and a trace of fluorine. The former were from one-tenth of an inch in thickness to one inch. They were laminated, of a grey color, and had much the appearance of volcanic tufa; they consisted principally of carbonate and sulphate of lime with a little magnesia, protoxide of iron, silica, and carbonaceous matter—the last two, the silica and carbonaceous matter, probably chiefly derived from the smoke of the engine and the dust in the air. From the engineer's report it would appear that the thinnest—the incrustation of about one-tenth of an inch, had formed in about a week, during which time the locomotive had run about 436 miles, and consumed about 10,900 gallons of water.—*Ibid.*

On the Value of the Gaseous Escape from the Blast Furnaces at the Ystalfera Iron Works, in Continuation of a Paper read at the Meeting of the British Association in 1848. *By* Mr. Palmer Budd.*

Mr. Budd stated that, since the meeting of the Association at Swansea, he had continued, and with increased success, to apply the waste gases that escaped from the top of blast furnaces, to the manufacture of iron; and it was the result of his further experience applied to the whole of his furnaces (nine in number) since that period, that he now wished to submit to the Section. Mr. Budd then referred to his mode of applying the gaseous escape, and said it was well known that there were two descriptions of furnaces used for metallurgic purposes. The one was the blast furnace, into which air was injected, by mechanical means, at a great density, so as to penetrate upwards of 40 feet of dense materials; and the other was the reverberatory furnace, where the fire was produced by means of the draught of a chimney stack. What he had accomplished was by combining these two, so that the gaseous products of the furnace, instead of escaping through the tunnel head, were drawn sideways by a high stack, and passing through the stoves and boilers, leave behind the necessary temperature of the blast and of the steam. In a blast furnace the ores are smelted before the *tuyerès* by the conversion of the solid carbon into carbonic acid, which, passing up through the middle region

* From the London Athenæum, for August, 1850.

of the furnace into a bath of carbon, was re-converted into carbonic oxide, capable of combining with a further dose of oxygen. It would be thus seen that the whole of the carbon of the fuel should be present at the top of the furnace in a gaseous form. When the British Association met at Swansea, he had not used the gaseous escape at any great distance from the furnace, his stoves and boilers being very closely contiguous. Further experience, however, had proved that by the aid of a stack at the end of the chain of sufficient dimensions, the gaseous escape from the furnace might be made to travel in the most tortuous directions, descending to the stoves built for heating by the usual fire-places, and traversing the boilers; the only condition absolutely necessary being that there should be an unbroken communication with the high stack at the end, into which the gaseous escape might at last pass, and by which it was drawn forward, instead of passing off wastefully at the tunnel-head. When, however, the draft was carried downward, and to long distances, he had found it necessary to drop into the top of the furnace a hopper or funnel, made of sheet-iron, which acted as a shield at the mouths of the horizontal flues, and prevented them from either being affected by high winds, or from being choked up by materials thrown into the furnace. The reason, no doubt, why this funnel was not applied before was the great apparent temperature at the funnel-head. In practice, however, it was found that until the gaseous escape mingled with the atmosphere, its heating power was not such as to injure sheet iron, or even to make it red-hot. In fact, so long as there was an escape upwards, the iron funnel would not be injured. The damage arose during and after stoppages of the furnace, when the blast was obstructed in its passage upwards by the settlement of the materials in the furnace, so that the atmosphere rushed down to meet the ascending gases, and, of course, caused a very high local temperature. His practice was to exclude the atmospheric air as much as possible. The affinity of the gases for oxygen was so great that the air leakage raised the temperature quite sufficient for safety, whilst the full combustion of the gaseous escape would melt down the bricks in the flues, and destroy the texture of the iron tube. It was not possible for him to say what combinations took place at high temperatures, where carbonic oxide, carbonic acid, hydrogen, and nitrogen, were mixed in such proportions. At any rate, he found a smothered combustion to be the most suitable and economical for the purposes in view. He was happy to say that, at length, the application of the gaseous escape had been tried in Scotland; and that at Dundyvan and elsewhere it was now in successful operation. The peculiar quality of the furnace coal of Scotland being what was called in South Wales "free burning," which, when put into the furnace raw, coked sufficiently in its descent, gave out an enormous escape, so much so that, upon a rough estimate, he calculated that the waste from one furnace in Scotland was sufficient to heat the blast, and to raise the steam for three. With anthracite coal, the minimum effect was obtained, as it was a dense fuel of nearly 95 per cent. of solid carbon; but in Scotland there would be an enormous surplus at the tunnel head. He observed that the saving at the Dundyvan Iron Works was stated to be about $1\frac{1}{4}$ tons for each ton of iron produced. Supposing, therefore, 600,000 tons

of iron to be the produce of Scotland, and supposing the value of the coal used to be 3*s*. a ton, the saving that would thus be effected on the make of Scotland would amount to 112,500*l*. a year; to which might be added 20,000*l*. a year of saving in wages and repairs, which would make a total saving of 132,500*l*., or about 4*s*. 5*d*. a ton on the produce of Scotland, which on the present price of 44*s*. per ton, was about 10 per cent. on the value. If the gaseous escape could be extended to the uses of the forge, a further saving of three tons of coal would be effected,—thus making, at least, a saving of 20*s*. a ton on all the iron manufactured into bars, sheets, and rails.—*Ibid.*

On a Peculiar Form produced in a Diamond when under the influence of the Voltaic Arc. By S. P. Gassiot.*

M. Jaquelin was the first to show that when the diamond is submitted to the high temperature and influence of the voltaic arc, it quickly becomes converted into a black carbonaceous matter, having all the appearance of coke:—the diamond when in a native state is an insulator or non-conductor of electricity, but when thus changed into coke it becomes an excellent conductor. At the Chemical Section of the British Association, held at Oxford, in 1847, Dr. Faraday exhibited some specimens of the diamond coke which had been forwarded to him by M. Jaquelin, and subsequently, on the 16th of June, 1848, he publicly showed the experiment in London, in the theatre of the Royal Institution. On repeating the experiment a short time since before a few private friends, I obtained a product so totally different from that of M. Jaquelin, that I am induced to bring the subject before this Section, in the anticipation that it may tend to elicit some observations on a phenomenon which at the time attracted the attention of many electricians. The apparatus I used in the experiment consisted of forty series of the usual size of Grove's nitric acid battery,—the terminals were made from two pieces of well burnt box-wood charcoal, that attached to the positive or platinum end of the battery, being formed in the shape of a small cup or crucible, in which the diamond was placed,—to the negative or zinc end of the battery, a piece of the same charcoal (but *pointed*) was attached. The experiment was then made in the same form as described by M. Jaquelin, by first making contact with the two charcoal terminals, then bringing the flame in such a position as to cause it to *surround* the diamond;—in less than one minute the diamond as well as the electrode became in a state of intense ignition. The diamond gradually increased in size, rolling about in the heated crucible, when it suddenly expanded, forcing itself upward on the negative terminal, at which moment I separated the electrodes. The diamond, which was in a state of intense ignition, remained attached to the negative terminal. When cool, it exhibited the same state as it now presents. It was expanded to eight or ten times its original bulk. Instead of becoming a black carbonaceous substance, and a good conductor, it has a vitreous white opaque appearance, and remains a non-conductor. It has also a deep circular cavity

* From the London Athenæum, August, 1850.

on that portion which was opposite and nearest to the positive electrode; that part which was in contact with the negative electrode being clearly discernable by a small portion of the box-wood charcoal remaining attached to it. The centre of the cavity appears to be still brilliant, as if that portion of the diamond had not been in a complete state of fusion. In one or two other experiments the diamonds disintegrated, the fragments remaining in a carbonaceous state. Since which I have not had the opportunity of repeating the experiment.—*Ibid.*

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*The Dover and Calais Electric Telegraph.**

Since the sinking of the first wire, circumstances have occurred calculated for a short time to retard the carrying out the project to completion, seeing that, in order to the complete establishment of an integral line of telegraphic service between London, Paris, and the continent, the promoters have to obtain a grant from the French Government of the eighteen miles of line extending from the coast to Calais, from which point to Paris the wires are erected. To secure that concession of this section, in the way of which some difficulties present themselves, Messrs. Brett, Wollaston, and Edwards, Directors of the undertaking, are now at Paris, awaiting the return of the President of the Republic, who granted the original decree, and to negotiate with the Government authorities on the subject.

In the meantime, experience of the experiments already made goes to prove that a stronger species of telegraphic tackle will be required. By the terms of contract with the French Government it was enacted—"That the Government does not reserve to itself the right of making any similar concession," but "that in case the experiment shall not result in a favorable execution by the 1st September, 1850, the right conceded will revert to the French Government." Consequent on the conditions laid down in the contract the promoters successfully submerged the wire; but, as is well known, it was subsequently cut asunder by some rocks on the French coast.

Since this happened, divers have been down, and on examination it has been found that where the rupture of the coil occurred it had rested on a very sharp ridge of rocks, about a mile out from Cape Grinez, so that the leaden weights, hanging pannier-like on either side, in conjunction with the swaying of the water, caused it to part at that point, while at another place in-shore the shingle from the beach had the effect of detaching the coil from the leaden conductor, that carried it up the Cape. The wire in its gutta percha coating was consequently cut in two places, representing a remnant of wire, of about 400 yards, which was allowed to drift away, till it came into the possession of a fisherman at Boulogne, who made a demand of 60 francs for the injury he alleges it did to his nets. Complaints are made by the fishermen, both on the English and French coasts, that the existence of this wire will interfere with their deep sea fishing, and that its track over the Varne and elsewhere is in the way of places most frequented by fish. It is intended, however, at

* From the London Mechanics' Magazine, September 28, 1850.

the suggestion of Mr. J. W. Brett, to pay these people an annual rental, and to establish for their families a philanthropic fund, to induce them to unite in the protection of this great national enterprise. The assistance of the Admiralty has also been secured for the issue of prohibitory orders against fishing on the route of the electric sea line, and against ships dropping or dragging anchors over its site. The authorities of Calais and Boulogne have intimated that they will send drummers round the town to advise fishermen not to fish on these spots, and the Company will apply for powers to punish as a misdemeanor any attempts at injuring the wire. The line of wire where it was dislocated is now securely fastened on to the end of a large buoy. Her Majesty's ship Widgeon, with Captain Bullock, has traversed the rest of the track, fishing up at intervals the whole of the sunk wire out of 100 feet and 150 feet of water, and laying it down again; thus proving that it has not drifted, and that there were no currents to remove it.

The promoters of the project appear to be fully apprehensive of the inadequacy of the present arrangements, and all their ingenuity is at work to be prepared to meet the emergency. Of currents it may be stated that there is no fear, since it has been ascertained that at certain fixed fathoms, even in the rapids of the Mississippi or at the Menai, there are none below three or four fathoms, and that at five fathoms there is calm water. In order to meet all existing or conjectured difficulty, the character of the undertaking, so far as its magnitude and solidity are concerned, will now be altered. The electric wire, thin as a lady's staylace in itself, will now be incased either in a 5 inch or a 10 inch cable of the diameter of those that placed the Britannia tubes in position, and these will be submerged by the aid of enormous weights. The wire will be imbedded in this gigantic coil or cable, composed of what is called whipped plait with wire rope, all of it chemically prepared, so as to protect it from rot, and kyanised; the whole to be chained down, as it were, as the rails are on a railway, by the gravitation of the huge weights in the bottom of the sea.

Dover, September 15.

For the Journal of the Franklin Institute.

Description of the Steamer "Monumental City."

As accurate data in steam navigation are among the most valuable knowledge of the day, the following notes on the "Monumental City"—a screw steamship just completed at Baltimore, by Murray & Hazlehurst—may be acceptable to the world of steam engineers.

HULL.—Of wood, coppered; length on deck, 185 feet; keel and forerake, 176 feet; extreme breadth of beam, 30 feet; draft of water with mean load, 13 feet; depth of hold to lower deck, 15 feet—to spar deck, 24 feet; She is barque-rigged; the fore and main masts are rigged alike, with the topsail divided in two parts, there being two topsail yards for convenience of handling;—the same arrangement obtains in the U. S. steamship "Massachusetts." The vessel is intended to ply between Panama and San

Francisco, and the water lines are a little full, in order to give stiffness under canvas, as well as to obtain displacement for load.

ENGINES.—Two oscillating cylinders, 44 inches diameter and 3 feet stroke, connected upon the same crank pin, nearly at right angles. Each cylinder has a separate condenser, with a pipe of communication between them. There is but one air pump, which is vertical and double-acting: 26½ inches diameter, and 22 inches stroke, worked from a crank on the forward end of the main shaft. The steam valve is an equilibrium slide, (one to each cylinder,) worked by an eccentric on the main shaft, and cutting off by lap at ¾ths of the stroke. There is also an independent expansion valve, worked by cams on the main shaft. The piston rod is continued through the piston, and protrudes from the back end of the cylinder, in order to serve as a guide to the piston. The piston and stuffing boxes are of the usual dimensions for engines of stationary cylinders. The engines were designed by Mr. Murray, and are of the most simple and compact arrangement, well adapted for their purpose, and unexceptionable in design.

BOILERS.—The boilers are tubular, planned after the usual English type, and are two in number, containing in the aggregate about 100 square feet of fire grate, and 3000 square feet of heating surface. They supply the engines with about 12 lbs. of steam above the atmosphere, from salt water, cutting off at ¾ths the stroke.

SCREW.—The screw is regular, and is composed of cast iron; pitch 25 feet, diameter 12 feet; length on shaft for 5 feet diameter, 2 feet; for remainder of diameter, 3 feet,—a projection of 6 inches being given on each side. The eye of the hub is six-sided, and measures 14½ inches across opposite angles;—thickness of hub at ends, 5 inches; at centre, 6 inches. There are four blades; thickness of blade at shaft, 4 inches, diminishing to ¾ in. at periphery. From the above dimensions, it will be perceived that the helicoidal surface amounts to about $\frac{45}{100}$ of one convolution of the thread. The edges of the blades are chamfered on the side opposite the propelling face. The screw is cast in one piece, and was placed in the vessel in the condition it came from the sand.

PERFORMANCE.—The vessel having a draft of 9 feet forward, and 12 feet aft, was tried in Baltimore harbor on the evening of November 14, and made the distance between the Lazaretto Lighthouse and the Fort on Teller's Flat in 32 minutes—calm and no tide; distance obtained from the office of the Coast Survey, 4 statute miles. Revolutions of engines and screw, 42 per minute; speed of vessel, 7·5 statute miles, speed of screw, 11·97 statute miles, per hour; slip of screw, 37¼ per cent.; steam pressure in boilers above atmosphere, 17 lbs. per square inch; cut off at ¾ stroke.

The next day, the vessel having a draft of 10 feet forward, and 12½ feet aft, there being an ebb tide and light airs, made the same distance, from Lazaretto Lighthouse to the Fort on Teller's Flats, in the same time of 32 minutes. Steam pressure in boilers, 14 lbs. per square inch; cut off at ¾ stroke; revolutions of engines and screw, 40 per minute; speed of vessel, 7·5 statute miles per hour; speed of screw, 11·364 statute miles per hour; slip of screw, 34 per cent.

In continuation, made the distance between the Fort and Bodkin Island

Lighthouse, bearing due W., in 1 hour 23 minutes; distance by Coast Survey, 8 statute miles,—allowing for sinuosities of channel, 9½ miles; revolutions of engines and screw, 37 per minute; steam pressure in boilers, 14 lbs. per square inch; cut off at ¾ stroke; speed of vessel, 6·867 statute miles; speed of screw, 10·514 statute miles; slip of screw, $34\frac{7}{10}$ per cent.

Returning up Chesapeake Bay, November 17, made the distance from Cove Point to Bodkin Island Lighthouse in 7 hours, against head wind and tide; distance by Coast Survey, 51½ miles. Revolutions of screw and engines, 38 per minute; steam pressure in boilers, 13 lbs. per square inch, cut off at ¾ stroke. Speed of vessel, 7·367 statute miles per hour; speed of screw, 10·796 statute miles per hour; slip of screw, $31\frac{8}{10}$ per cent. The information contained in this paragraph was communicated to me; that in the others was observed by me.

Total cost of vessel, about $80,000; of machinery alone, about $30,000.

While the vessel remained fast to the wharf, the engines were put in motion with wide throttles, and with 11 lbs. steam pressure in the boilers, cutting off at ¾ stroke, made 23 revolutions per minute.

During the above trial trip, the top of the blades were about 6 inches out of water; the slip of the screw being so considerable, there was left behind the vessel a long and broad wake. The trial trip being near the head of tide water, the speed of the vessel was but little affected by that cause. I.

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*Comparative Elasticity of Wrought and Cast Iron.**

The mean ultimate resistance of wrought iron to a force of compression, as useful in practice, is 12 tons per square inch, while the crushing weight of cast iron is 49 tons per square inch; but for a considerable range, under equal weights, the cast iron is twice as elastic, or compresses twice as much as the wrought iron.

A remarkable illustration of the effect of intense strain on cast iron was witnessed by the author, at the works of Messrs. Easton and Amos. The subject of the experiment was a cast iron cylinder $10\frac{5}{8}$ inches thick, and 14½ inches high, the external diameter being 18 inches.

It was requisite for a specific purpose to reduce the internal diameter to 3½ inches, and this was effected by the insertion of a smaller cast iron cylinder into the centre of the large one; and to insure some initial strain, the large cylinder was expanded by heating it, and the internal cylinder being first turned too large, was thus powerfully compressed.

The inner cylinder was partly filled with pewter, and a steel piston being fitted to the bore, a pressure of 972 tons was put on the steel piston. The steel was "upset" by the pressure, and the internal diameter of the small cylinder was increased by full three-sixteenths of an inch; *i. e.*, the diameter became $3\frac{1}{1}\frac{1}{6}$ths of an inch! A new piston was accordingly adapted to these dimensions,—and in this state the cylinder continues to be used, and to resist the pressure; the external layer of the inner cylinder was thus permanently extended $8\frac{1}{5}\frac{1}{0}$ths of its length. In fact, it can

* From the London Mechanic's Magazine for October, 1850.

only be regarded as loose packing giving no additional strength to the cylinder.

Under these high pressures, when confined mechanically, cast iron as well as other metals appears, like liquids, to exert an equal pressure in every direction in which its motion is opposed.—*Clark's Britannia and Conway Tubular Bridges.*

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*Mr. Nasmyth's Test for Oils for Lubricating.**

In all the contrivances which have been proposed as oil tests, a most important element has been left out, viz., *time;* inasmuch as the evil which is experienced from the use of a bad quality of oil is only developed after the lapse of several days, when, by the action of the oil upon the metal with which it is in contact, together with the action of the air, such oils become viscid, and begin to clog instead of facilitating the movements of the parts of the machinery it was intended to lubricate.

In the more delicate descriptions of machinery, such as chronometers, watches, clocks, &c., such a defect as the thickening of the oil by lapse of time is a most serious evil; and in examining into the comparative fitness of certain oils for such applications, if we do not include *time* as an element in our examination, we shall be led to form most false conclusions, inasmuch as it is the case that for the first day or two some kinds of oil (linseed oil for example) perform the lubricating duty very well; but at the end of the second or third day they become so thick and viscid as to entirely arrest the motion of the machinery.

The most valuable quality in an oil intended for the lubrication of machinery is *permanent fluidity.* That oil which will for the greatest length of time remain fluid in contact with the iron or brass is, without doubt, the most useful for the purpose. Hence, as before said, the necessity of including the element of *time* in any experiment on the comparative value of such oils.

Some idea may be formed of the importance of having the means of arriving at correct conclusions on this subject, when we know that in some spinning establishments there are upwards of 50,000 spindles in motion at the rate of 4000 or 5000 revolutions per minute! The slightest defect in the quality of the oil in such a case, by its becoming viscid, tells in the most serious way upon the quantity of fuel consumed in generating the power required to maintain at this high velocity such a multitude of moving parts. The slight increase of fluidity consequent on the rise of temperature, caused by the lighting of the gas in the rooms of a cotton-mill, makes a difference of several horses power in the duty of the engine of an extensive establishment.

The oil test we have now to describe, and which is an invention of Mr. Nasmyth's, consists of a plate of iron 4 inches wide by 6 feet long, on the upper surface of which six equal-sized grooves are planed. This plate is placed in an inclining position, say 1 inch in 6 feet. The mode of using it is as follows:—Suppose we have six varieties of oil to test, and we are desirous to know which of them will for the longest time

* From the London Mechanic's Magazine for October, 1850.

retain its fluidity when in contact with iron and exposed to the action of the air; all we have to do is to pour out *simultaneously* at the upper end of each inclined groove an equal quantity of each of the oils under examination. This is very conveniently and correctly done by means of a row of small brass tubes. The six oils then make a fair start on their race down hill; some get a head the first day, and some keep a head the second and third day, but on the fourth or fifth day the truth begins to come out; the bad oils, whatever good process they may have made at the outset, come soon to a standstill by their gradual coagulation, while the good oil holds on its course, and at the end of eight or ten days there is no doubt left as to which is the best; it speaks for itself, having distanced its competitors by a long way. Linseed oil, which makes capital progress *the first day*, is set fast after having traveled 18 inches, while second-class sperm beats first-class sperm by 14 inches in nine days, having traversed in that time 5 feet 8 inches down the hill. The following table will show the state of the oil race after a nine days' run:—

RESULTS OF OIL TEST.

Descript. of Oil.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Best sperm oil ..	2 8½	4 2	4 5¾	4 6	4 6	4 6	4 6⅜	Stat.	
Com. sperm oil .	1 7	3 9	4 6¾	4 11	5 1½	5 4	5 6¾	5 7⅜	5 8
Galipoli oil	0 10½	1 2¼	1 6	1 6½	1 7⅝	1 8¾	1 9	1 9½	1 9½
Lard oil	0 10½	0 10½	0 10¾	0 10¾	0 11¾	Stat.			
Rape oil	1 2½	1 6¼	1 7	1 7⅛	1 7¼	1 7¼	1 7¼	1 7¾	Stat.
Linseed oil	1 5½	1 6	1 6¾	1 6¼	1 6½	1 6½	1 6¾	Stat.	

Improvements in Forging Iron. *By* Mr. James Nasmyth.*

[Read before the Mechanical Section, British Association, Edinburgh.]

Before proceeding to describe the nature of the improvements in question, Mr. Nasmyth made some remarks on the value and importance of any improvement which tended to increase the certainty of the production of sound and perfectly solid forgings of wrought-iron, more especially those massive forgings required for such purposes as paddle-shafts for marine engines, crank and plain axles for locomotive engines, anchors, and such like; on the soundness of which both life and property, to a vast amount, may depend. Mr. Nasmyth instanced several cases in which paddle-shafts of marine engines had given way, although, in the first instance, they had all the *outward* aspect of the most perfect soundness, but which, on fracture, exhibited the existence of original defect, in being little else, internally, than a mass or bundle of loose bars of iron, which had never been in a sound welded union, but had only been held together by the exterior, where alone the welding had been so far perfect.

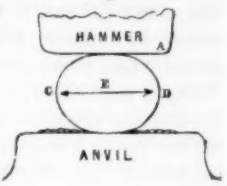
The chief cause of such defects was traced to the action induced on the

* From the London Mining Journal, No. 791.

centre part of the metal of such shafts, by the action of hammering such cylindrical forms between two *flat* surfaces, as in the case of a forge hammer and anvil of the ordinary construction.

Mr. Nasmyth exhibited a diagram, of which fig. 1 is a copy, in order to illustrate the action induced on the centre portion of a cylindrical forging, when produced under the action of a flat-faced hammer and anvil.

Fig. 1.



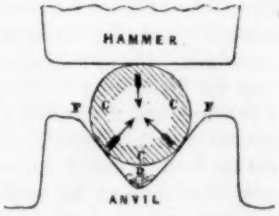
It will be seen at once that the action induced on the centre portion of the metal of a shaft or such like cylindrical form, by the successive blows of a *flat*-faced hammer and anvil, as A and B, is to cause the work to spread out or extend in the direction of E D, E C (as represented by the double pointed arrow in the figure), and as the flattened out form has to be attempted to be corrected by turning the shaft round and round on the anvil, so that each successive blow may be made to correct the spreading out caused by the previous blow, the result of this action is a fretting or mincing of the centre part of the metal of the shaft, resulting in a separation of the metal throughout the entire centre portion of the shaft, somewhat after the manner indicated in fig. 2, frequently to such an extent as to permit the passage of air or water from end to end of shafts forged in this manner. The effect of this kind of unsoundness is, that it is certain, sooner or later, to work out towards the exterior, and, in all probability, result in a "break down" more or less disastrous in its consequences.

Fig. 2.

Mr. Nasmyth then proceeded to describe his improved form of anvil face, by the employment of which all such defects as detailed above are avoided. Such has been the perfect success and excellent results which have attended the use of his improved anvil face, that its adoption has become almost universal, and the production of absolutely sound, solid, wrought iron shafts, of whatever magnitude, rendered equally easy as certain.

A (fig. 3), represents the form of Mr. Nasmyth's improved anvil face, which he terms a V anvil, between the jaws of which the work to be hammered is placed, as indicated by a cylindrical shaft seen in section marked C, C, C. A glance at fig. 3 will, no doubt, render its action evident—viz., that the effect of each blow of the hammer on the work, C, C, C, instead of causing, as in the case of fig. 1, a *diverging* action on the centre portion of the work, occasions, on the contrary, a *converging* action, as represented by the three arrows, and instead of having the centre portion of the metal of the shaft rendered less compact and solid by the action of the blows of the hammer, we have quite the contrary effect produced; besides which, owing to the wedge-like form and action of this V anvil face, the compressing effect of the blow is most importantly enhanced, and the ease and rapidity with which such cylindrical work

Fig. 3.



as shafts and the like can be produced by such means is most remarkable, so much so as to enable the forgeman to hammer out *at one heat*, by means of this V anvil, as much as would require three heats on the common flat-faced anvil; add to which the vast convenience which the fork-like form of the V anvil yields, in keeping the work at all times right under the centre of the hammer, as it is turned round and round to receive the successive blows, which, in the case of work of the largest class, is a matter of no small trouble. Another advantage consists in the free passage, or exit, which is at all times preserved for the escape of the scales and impurities which fall from the hot iron during the process of hammering, which scales fall down towards the apex of the V at D, and trickle away—thus removing the cause of blemish and roughness which is occasioned by such scales collecting on the face of the flat anvil, and getting beat into the surface of the forging.

It will be seen, on inspecting fig. 3, that one such V anvil face as there represented will accommodate a vast range of diameter of work—namely, all diameters such as will neither absolutely rest on the bottom of the apex, D, or on the corners, F, F.

Mr. Nasmyth has taken every means by the most free communication to promulgate among those interested the advantages of this V anvil, and has been rewarded by seeing its use become almost universal. Mr. Nasmyth stated that an angle of 80° was found by him to be most generally suitable for the inclination of the sides of the V, and also that the edges should be well rounded off, and the surface of the V sides curved in the direction of the *axis* of the work to the extent of $\frac{1}{8}$th of an inch in 12 inches, so as to be "prowd" in the centre, and so facilitate the extension (axis ways) of the work. The great simplicity, as well as the important results which are yielded by the employment of this V anvil face, has in no small degree, contributed to its almost universal adoption. Its employment renders the production of perfect sound work easy and certain.

Mr. Nasmyth next proceeded to describe the second part of his improvements in forging iron, which consists, as in the first case, of means equally certain and simple in producing sound boiler-plates. Mr. Nasmyth prefaced the description of his improvements on this truly important subject by detailing the nature of the most frequent *cause* of unsoundness of iron forgings generally, and in boiler-plates in particular—namely: the imperfect expulsion of the molten oxide of iron "scoria," or "cinder," as it is termed, which, in every case of welding, hot iron covers and clings to the surface of the metal; and, if left interposing between the welded surfaces, is certain to occasion a defect greater or less, according to the surface of junction it occupies. The frequency of this interposing scoria as *the true cause* of unsound forged work, was forcibly alluded to by Mr. Nasmyth, and shown to be the most fertile source and cause of the failure of wrought iron work, resulting as such too frequently does in the most sad and disastrous accidents—such as the failure of the links of chains and anchors, and in the costly and often distressing results arising from defective (*i. e, blistered*) boiler-plates.

In respect to the links of chains, Mr. Nasymth mentioned as the result of an extensive series of experiments on the strength of chain cables, on

which, as member of the "committee on metals," he was employed by the Admiralty, out of every 10 cases of fracture, eight were occasioned by defective welding, as evinced by the appearance of the surfaces, which present to a practical eye appearances not to be mistaken, owing to the very peculiar aspect of the surfaces of the *apparently* welded metal, between which surfaces the oxide, or scoria, had not been duly expressed.

Mr. Nasymth further described the condition absolutely requisite to perfect welding—namely: not merely that the surfaces we desire to weld should be really "welding hot," but also that, when brought into contact, no particle of the scoria, which inevitably clings to the metal while welding hot, should be permitted to remain interposing between such surfaces. If such material is left interposing, we are certain to have defect and unsoundness, to a greater or less extent, as the result.

In order the more clearly to detail his improvements on this important subject, Mr. Nasymth exhibited a colored drawing, representing the usual form and arrangement of a "pile" of "slabs," such as are employed when welded together, to form a mass of iron, from which boiler-plates, or bars of iron, are rolled. Fig. 4 represents such a "pile" of "slabs" which, having been, as is generally the case, produced under the action of a forge hammer and anvil, having flat or, as is generally the case, slightly *convex* surfaces, causes the slabs so produced to have certain *hollow* parts, or slightly concave portions of their surfaces, so that, when piled one upon the other, as in fig. 4, the risk of having hollow spaces is almost certain. The hollow spaces are represented in the figure by the dark irregular lines between the slabs.

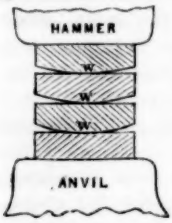
Fig. 4.

Referring to fig. 4, A, B, C, D, represent a pile of four slabs, laid on the anvil welding hot. Owing to the *concave* irregularities of the surfaces; the parts most certain to come into contact first are generally the exterior edges of the slabs. The effect of the blows of the hammer is first to weld the parts in natural contact, and by continuance of the blows the interposing scoria, or cinder, is expressed in a degree more or less perfectly, according to the energy of the blows, and the deepness of the convex, or hollow patches, betwixt the slabs. *So long as there exists an exit*, or passage, for the scoria all is well; but, as generally happens, some portion of the scoria lurks behind, after all chance of escape is removed by the welding of the exterior portion of the surfaces of the slabs. The result of this is that we have, to a certainty, a defect, greater or less in amount, according to the quantity, or surface, over which the *enclosed* scoria extends. Once such scoria is shut up between the surfaces of the slabs no amonnt of after hammering will ever expel it, but, on the contrary, will only tend to its extension over a larger surface; and, as before said, so long as a particle of this scoria is left interposing, so have we a degree of unsoundness in proportion.

Great as this evil is, and common as it is as a fertile cause of defective iron-work, and the more especially so in the case of boiler-plates, the means of avoiding such source and cause of defect is as simple as the results are important; and it is to be hoped that the free and open communication which Mr. Nasmyth has made of his views on this subject

will be answered in the most acceptable way by the general adoption of his improvement, as certain means of avoiding the occurrence and existence of all such causes of defective boiler-plates and forge work generally, which improvements consist simply in so forming the surfaces which we desire to weld together that a free exit may be preserved to the last for the escape of the molten oxide, or scoria, until the entire surfaces of the parts we desire to weld are thoroughly incorporated by the welding property, under the action of the hammer, or rolls, as the case may be.

Fig. 5.



In order to accomplish this most important and desirable object, Mr. Nasmyth forms the surfaces of his slabs *convex* (see fig. 5), by which most simple means a most perfect free exit to the scoria or interposing impurity is maintained to the last moment, the welding commencing at the centre part of the contact, W, and extending outwards towards the edges under the action of the successive blows of the hammer, or squeeze of the rolls; but, as before said, an open door is kept for the escape of the scoria, until the surfaces unite from the centre, W, to the outside edge, Z, Z, Z, Z. Here, then, by an arrangement, or formation, of the surfaces we desire to weld we have the most certain and simple means of procuring a perfectly solid sound mass of iron, which, when beaten, hammered, or rolled down to whatever thickness we desire, will retain to the last all the qualities of the one sound solid mass we had converted it into by this most simple improvement—viz., giving to the surfaces we desire to weld *a convex* form, and relation to each other.

Mr. Nasmyth concluded his observations on these important subjects by an earnest appeal to the members of the mechanical section to diffuse, by all means in their power, the information which, on this as on all such subjects, he will ever feel the highest pleasure in communicating to the practical men of his profession, who may think fit to accept these results of an active life, which he finds so much pleasure in freely sharing with them.

Proportions of Steps and Staircases. By J. Burges Watson*

As the following system may not be generally known to the profession, I send it, hoping that other members may, from time to time, communicate their ideas on points connected with our art:—

The late Mr. Thomas Tredgold named it to me as one to govern us in carrying out a properly proportioned step. He stated, that as it was admitted that a person of ordinary stature moved on level ground over a space of two feet at each step, and as the lifting of the foot was attended with about double the amount of exertion as advancing it forward, he considered the twenty-four inches should be so divided, that *twice* the rise, added to *once* the tread, should *always make up* that number; for instance, if the step was 6½ inches rise, it should be 11½ inches tread, or 6⅜ inches rise to be 11¼ inches. I begin with these figures, as giving

* From the London Architect, for September, 1850.

good proportioned steps (for I have always considered a 6-inch rise as rather less, and a 6¾-inch rise as rather more, than the best proportion for general use.) But in forming a handsome staircase, where we are seldom confined either as to height or space on the plan, we may exercise our skill and judgment as we like, by having our steps 4 inches by 16 inches tread, or 5 inches by 14 inches tread; or, in a contracted space, when a steep staircase is *unavoidable*, 7 or 8 inches rise × 10 or 8 inches tread respectively—*all making up the 2 feet.* And it will be found that the *going*, as it is called, will, by this rule, be about the best that could be adopted, although I need hardly say that both extremes as to rise are better avoided.

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*The Atmopyre: For Converting Gas into Fuel for Economic Uses.**

Many have been the attempts and suggestions to substitute coal gas, and other combustible elastic fluids, for coal fires, as far more cleanly, more easily managed, and as giving a far more regular and quickly-adjustable temperature. None of the plans hitherto adopted have, however, met with more than partial success, such as the application of gas burners to hot plates, boiling liquids, &c. It has been reserved for Mr. D. O. Edwards, a member of the College of Surgeons, to hit upon a plan at once founded on the most scientific principles, with an adaptability of being applied to every purpose for which open coal fires have hitherto been employed. It is well known that flame is a hollow cone, its exterior being formed by the evanescent particles of carbon, which being, for the moment, precipitated in a solid form after the combustion of the hydrogen, and raised to a white heat, give out light in virtue of that transient solidity. This occurs the instant before the union of the carbon with the oxygen of the atmosphere, and their conversion into carbonic acid, which forms an invisible pellicle round the flame. The heat to which this carbonaceous shell is raised is very high, but as soon as it is engendered, it is carried away by currents of the surrounding atmosphere. The possibility of arresting and detaining this heat was the problem the inventor proposed to solve. Meditation on the Davy safety-lamp afforded a clue. This lamp is a chamber, which, when its preserving agency is required, is filled with flame; the walls are perforated with minute holes, through which air and gas freely pass, but which are impermeable to flame. The incandescent gas, in its transit through these apertures, is robbed of its heat, the flame is extinguished, and the heat is developed in the wire-gauze, which becomes red-hot. Here, then, was the principle; the material suitable was the next consideration; all the metals are too oxidisable, except platina, which was too expensive; a mixture of one-third china-clay, and two-thirds common pipe-clay, was employed. Cylinders of various sizes, from 2 to 4 in., were formed of this material, perforated with numerous orifices, and having a circular opening at one end, to screw on to a No. 4 gas burner. This cylinder, or hood, is the converse of the Davy lamp, the gas being inside instead of out; and on escaping through the holes, and fire being applied, the hood, in one minute, becomes red-hot, having the

* From the London Mining Journal, No. 787.

appearance of a mass of red flame; but an aggregate or battery of these hoods, placed in a circle, and covered with a case, are heated to an orange color, and a temperature has been obtained sufficiently high to melt the more refractory metals—gold, copper, iron, &c.

For warming apartments, this appears to us the most cleanly and efficient means ever yet proposed, and the inventor applies it in the following manner:—A battery of 12 "hoods" is inclosed in an earthenware case, which, becoming heated to 500° Fah., forms a repository of heat. This is placed in an outer case of china, terra cotta, or any other ornamental ware. The products of combustion are carried away by a small pipe into the chimney. The fresh air is brought from outside the dwelling through a tube about 6 in. diameter, which communicates, by means of a valvular iron plate, with the space between the two cases. The air ascends in this area in large quantities, is warmed in its transient contact with the inner case, enters the room through large holes in the top of the stove, at a blood-temperature, and spreads equally through the apartment. The fire presents a cheerful aspect through the wide orifice of the stove, which is covered with glass, and is visible to every inmate, and the expense of such a fire is 6d. per day, at the present price of gas.

This new fire is applicable to every variety of culinary operations—to roasting, boiling, baking, broiling, frying, stewing, and toasting, affording a steady, and easily adjustable heat. As roasting by this method is effected in close chambers, an idea may prevail that the meat is only baked, but such is not the case. In roasting, a heat of about 350° Fah. is sustained at the surface of the joint, which is slightly charred; the fluids in the interior of the meat are raised to a temperature of 212°, and the flesh is thus boiled in its own juices. The internal heat can never be above 212°, the boiling point, because at that point liquids are converted into steam, which never imparts, in its natural state, a higher degree of temperature. The atmopyre is undoubtedly an economic source of heat for all domestic purposes, can eventually be brought into use for all manufacturing uses, and as an agent for the prevention of smoke will be invaluable. Applied to refining gold and silver, the furnace may be kept up at an expense of 2d. per hour; in this case the argillaceous envelopes are doubled and trebled, to insure an accumulation of heat equal to what is known as the "wet" heat. To produce steam, 50 ft. of gas consumed per hour is equal to one horse power, and this heat increases at a given direct ratio with the size of the furnace. As coal gas can be safely compressed into one-sixtieth part of its bulk, the atmopyre is applicable to steam-boats without exception, whose voyages are limited to 20 days. The heat of the atmopyre is so susceptible of exact regulation, that the most delicate aromatic herbs have been desiccated by it. It affords means of purifying bedrooms, and warming every description of apartment or public or private building, and is most important in a sanitary view. Add to this, it not only possesses great cleanliness, but that great desideratum to an Englishman's fire-side, a cheerful fire, is hereby eminently obtained, for we can imagine nothing more brilliant than a battery of a dozen of these cylinders glowing in an intensity of incandescence. The following is an extract from a letter to Dr. Faraday, containing details of some of the experiments.

Mr. Palmer, the engineer of the Western Gas Light Company, writes me the following account of some experiments made by him:—

1. The gas was turned on to the 12 burners or "hoods," and the flames adjusted to blue small jets, which produced a flickering explosive combustion.

2. In three minutes the "hoods" had all acquired a dull red heat, and in 7½ minutes the concentric cube or cylinder surrounding the "hoods" had acquired the like temperature.

3. The combustion of the gas was so perfect, that the "hoods" were not discolored by undecomposed carbon.

4. In 17 minutes the average temperature of the large room, containing 8551 cubic feet of atmospheric space was raised from 65° to 70° Fahr., whilst the extraordinary small quantity of 2 cubic feet only of gas was expended. It is necessary to remark that there was no ventilation in the room during the said 17 minutes above the fire-places, the ventilators nearly level with the ceiling having been both closed, and the entire products of combustion were not permitted to escape. The apartment, for want of ventilation, had become rather unpleasant to the respiration. Reasoning upon the extarordinary amount of heat developed in Mr. Palmer's experiment, it occurred to me that if this amount of heat could be concentrated in a small compass, an enormous furnace could be produced, and I accordingly constructed a small furnace, consisting of 12 "hoods," inclosed in an earthenware cylinder of 6 inches diameter, and built in an oven of Stourbridge bricks, of 6 inches thickness; the interior area measured 8 inches cube, or 512 cubic inches. In two hours after this little furnace was kindled, a heat equal to the melting of silver was produced. In four hours its maximum heat was apparently produced, there being no indications of increased temperature on the surface of the little kiln afterwards. In 36 hours the iron burners in which the earthenware "hoods" were placed, were partially fused, being inseparably united to the earthenware.

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*On Resin and Water Gas.**

In a leading article in the *Mining Journal* of the 24th August last, we made some observations on Dr. Fyfe's report, on the character of Mr. S. White's patent hydro-carbon gas, and which report gave so contradictory an account of its properties and value to that which Mr. White claimed for it. Mr. J. W. Hodgetts, of Manchester, has now replied to Dr. Fyfe, and we must admit that his report appears founded on most careful analysis, and is marked throughout by candour and good feeling. He says the principal sources of error in Dr. Fyfe's very elaborate and very interesting report, are—"first, he has tried his experiments with an apparatus erected under an old patent of Mr. White, since abandoned, and replaced by an improved one under his new patent of 1849. Secondly, he has adopted a process essentially differing from that of Mr. White.—His retort was *stuffed with charcoal and scrap iron*, thus producing hydrogen, by allowing the water to come in contact with the hot iron, whereas Mr. White decomposes water with heated charcoal alone, and *subsequently*

* From the London Mining Journal, No. 787.

passes the resulting gases through heated iron borings. Thirdly, he begs the whole question at issue, by assuming throughout his argument that the gases produced by water merely *mix* with those arising from the resin, instead of *chemically combining* with part of them in their nascent state, as I hope presently to prove that they do. Fully agreeing with the doctor, as I do, in 'the extreme absurdity of putting any confidence in specific gravity alone as a test of the value of a gas for the purpose of illumination,' curiously corroborated by Prof. Graham himself; who states in his evidence on Croll's bill, that, 'unless an experiment on specific gravity is combined with an analysis, it may lead to fallacious results,' I will not imitate him in going at considerable length into this very question, but will simply state that I believe the average specific gravity of Mr. White's gas, after passing the lime purifiers, and being thereby deprived of most of its carbonic acid, slightly exceeds 700; to bring it to 924 would require an enormous quantity of carbonic acid." Mr. Hodgetts then proceeds to show, from his own observations, corroborated by the regular reports received from the towns and manufactories employing it, that each 1 cwt. of resin produces from 1500 feet to 1800 feet of gas, 4 gallons of resin oil, and two-thirds of a gallon of naphtha; or, using all the oil over again, which makes the product clearer, 2500 to 2800 feet of gas with two-thirds of a gallon of naphtha, the gas slightly exceeding our Manchester and Salford Cannel gas in illuminating power, as tried against the same candle by the photometer. Mr. White's process is simple enough. His vertical 6-feet retort, having a small quantity of iron borings at the bottom, is filled up with wood charcoal, which is, of course, brought to a high heat. A small stream of water falling upon the charcoal, is, either upon its direct contact, or subsequently as vapor, passing through 6 ft. of carbon, converted into carbonic oxide, carbonic acid, hydrogen, and a little light carburetted hydrogen. Most of the carbonic acid subsequently yields an equivalent of its oxygen to the iron, and passes off as carbonic oxide.

These mixed gases are now conducted from the bottom of the vertical retort by a pipe into the horizontal retort, where they instantly come in contact with those gases in the nascent state, which arise from the decomposition of a small stream of resin constantly falling on the red-hot retort —viz: olifiant gas, light carburetted hydrogen, naphtha, and a little light oil, besides a further small portion of each of the other gases. But now comes the main question on which the merit of Mr. White's invention chiefly hinges, viz., Do these gases form a simple mixture, or does the large quantity of carbonic oxide, proceeding from the water retort, so combine with either carbon or naphtha, as to obtain from them that illuminating power in which it is previously so confessedly deficient, as almost to justify Dr. Fyfe in classing it as *nil*, and "worse than nil?" Mr. Hodgett's reasons are these: 1. The known products of water decomposed by hot charcoal, if simply *mixed* with the equally well known products of resin decomposed by red-hot iron, in equal proportions, could not possibly produce a gas of much more than half the illuminating power of good Cannel gas, whereas they *do* produce one of superior power. 2. It has been found by repeated experiments, that if Mr. White's resin retort is worked without allowing the access of the water gas, it will be completely

choked up with a deposit of carbon in four hours; whereas, when worked in the usual way, it is by no means choked in 12 hours, though it ought then to be cleaned. If no combination has taken place where has all this carbon vanished to? 3. The combination of carbonic oxide with naphtha is the very ground on which Mr. George Lowe took out his patent for naphthalizing coal gas; indeed, he has often said that the more carbonic oxide the gas contained, the more highly illuminating power the naphthalized gas posseses; for, according to his own original and forcible words, "though carbonic oxide possesses no illuminating power in itself, it is the best possible beast of burden for carrying it."

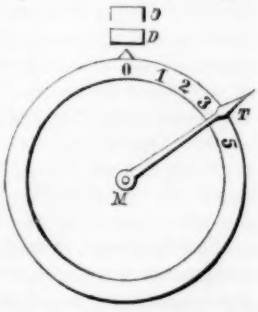
Mr. Hodgetts then proceeds to say that, at all events, Mr. White *does* produce 2500 feet of good gas, and two-thirds of a gallon of naphtha from each hundred-weight of resin, and does, by means of his water gas, greatly lessen the deposit of carbon in the resin retort; and as these assertions may, by experiment, be easily proved or disproved, all doubters are invited to "go and see." The spirited corporation of Manchester are at present allowing the erection of White's apparatus on their works, to try the economy of converting their immense production of tar into gas by its means; and the result of this trial will pretty much decide the merits of it.

Electric Telegraphs. *By* John MacGregor.*

In No. 1409 of your present volume there is a notice of a patent for some improvements in Electric Telegraphs—and amongst the abstracts of claims is the following:—

"8. An arrangement for sounding one out of a number of alarums:"

It is impossible, of course, to infer from this brief notice what are the particulars of the invention, and I am not aware of the mode at present adopted. If there be none, by which one only out of a number of stations may be signalled, then I would propose for consideration a plan for effecting this desirable object which occurred to my mind some time ago.



Let the accompanying figure represent a wheel, with marks 1, 2, 3, and 4, at equal distances on the circumference, and corresponding in number to the whole number of stations, say 60, connected by telegraph.

Let the axle of this wheel be made to turn once in a minute by clock-work, and the wheel be so placed on the axle that so long as a detent D rests on a projection P (opposite to the mark O), the wheel shall be at rest; but when D is lifted (by electricity), the wheel shall have sufficient friction-hold on the axle to cause it to turn round in the same time—that is, once in a minute. Now let R be a radial arm, capable of being placed at any of the marks 1, 2, 3, &c., and furnished with a projection T, which shall always pass free of D, but be caught by a catch C, provided that catch descends when

* From the London Mechanic's Magazine, for October, 1850.

T is within a certain distance on either side of the line C M. The catch C is supposed to be moved by electricity, and if it falls so as to strike T, the wheel will be stopped, a certain circuit completed, and a bell rung; but if C does not fall on T, it will be wholly inoperative on the machine.

A wheel, similar to that described, should be at every station, and in general the radial arm R at each station should be left opposite to the particular number denoting that station.

Thus the arm R, at No. 2 or No. 27, will be at angles at the line D M, particularly representing such stations respectively.

Supposing magnets, circuits, and bells to be so arranged that the bell of each station shall be set ringing only when a current is completed through C and T, we may describe the action of the instrument as follows:

If station No. 20 requires to correspond with No. 35, then—

1. Put the arm R opposite the mark 35 on the rim.

2. Send a current along the wire which will release the detents D *at all the stations*, and all the wheels will commence moving (at nearly the same rate.)

3. When the point T comes under C, (that is, in 35 seconds,) the similar point at station No. 35 will then be beneath its catch; therefore, send another current along the line, which will affect only wheels No. 35 and No. 20, and will ring the bell of 35.

4. After the communication of the message, return the wheels 20 and 35 to their original position. All the other wheels will have gone round for *one minute*, and will *themselves* have come into the exact position they were in at first.

By this means, the average time (in the above supposed circumstances) required to signal one station would be half a minute; but if that should be thought too long (!) the wheels might move at double the proposed rate, and the convenience of this plan will depend on the time of revolution of the wheels, and the amount of margin which can be permitted on either side of a perfect agreement of their motions.

We shall see that a comparatively inaccurate adjustment would not impair the usefulness of this simple apparatus; for if the catch C were made of such a breadth as to operate on T when it is at the distance from the line M C, represented by *nearly* half an interval on either side of that line, an error of nearly half a second in a minute may be allowed without deranging the instrument.

Howth, Sept. 14, 1850.

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*The New Steamship "Africa."**

The "Africa," the latest built of the British and North American royal mail steam fleet, sometime ago made the trip from Greenock to the Bell Buoy in sixteen hours, against a gale of wind which threw the spray clean over the vessel, and high up the funnel. But in the strength of the gale she made thirteen-and-a-half knots. She had previously made a trial trip from Greenock to the Cumbraes, on which occasion she sailed with comparative ease fifteen miles against a strong tide and wind in an hour and three minutes. She can scarcely be distinguished from her duplicate, the

* From the London Railway Journal, for November, 1850.

"Asia," being made from the same lines and moulds, both as regards hull and machinery. We may also add that we hear, that to keep up to the necessities of the times, the Company are about to lay down two more steamers, to be twenty feet longer than the "Africa," and of proportionate power.

	Ft.	In.
Length of keel and fore rake,	267	0
Breadth of beam,	40	6
Depth of hold,	27	6
Length on deck,	265	0
Breadth on do. at midships,	37	2
Depth of hold at do.,	27	2
Tonnage, 2,226 24-100		

A pair of side-lever engines of 814-horse nominal power. Diameter cylinders, 96 inches × 9 feet stroke; paddle wheels, diameter, 27 feet 7 inches, and 26 feet 10 inches effective; 28 floats, 9 feet 2 inches × 3 feet 2 inches, three sets of 28 arms, 8 floats in the water at 19 feet draft of water. Four flue boilers, twenty furnaces; bunkers to hold 890 tons of coals; thirty-eight hands in the engine-room. The "Africa" is built of the best British oak, and planked double out and inside, and between the frames is filled up, from the keel to the gunwale, with rock salt, to preserve the vessel from the dry rot. The number of her berths will enable her to carry 180 passengers. The quantity of coal she is estimated to carry is 900 tons, and she has capacity for the transit of 600 tons of cargo, not including ship stores.—*Liverpool Times.*

How Mud-Hole Doors ought NOT *to be put on Steam Boilers.**

A shocking accident occurred on the 10th inst., on board the "Erin's Queen," a screw steamer, trading between London and Belfast, by which the chief engineer, John Fergusson, was scalded to death. It appeared from the evidence that the mud-hole doors over the furnaces were *put on outside*, and the attention of the chief engineer being drawn to one of them leaking when steam was up, and the boat about to proceed down the river, he attempted to tighten up the nut, and in doing so the bolt broke, and the door was blown off, and the unfortunate man was blown with it to the other of the stoke-hole, and of course instantly scalded to death. Mr. Edmund Green, the engineer of another vessel, and Mr. W. K. Whytehead, C. E, were examined to show the error which had been made by the constructor of the boiler in putting the doors on the outside instead of the inside of the boiler. At the suggestion of the latter, the coroner read, for the guidance of the jury, the following passage from Bourne's *Treatise on the Steam Engine p.* 230. "It is much the safest way to put on both mud-hole and man-hole doors from the inside, with cross-bars on the outside to keep them closed. The plan sometimes followed of putting on mud-hole doors from the outside, and securing them by one or two bolts, is a practice we have already reprehended as full of danger, as if the thread strips, or the bolt breaks, the door will fly off, and the boiling water rush out, scalding every one in the vicinity. Mud-hole doors of this kind, even if they leak, cannot be screwed up to tighten them when the steam is up, as there is a perpetual risk in tightening the doors of stripping the thread, or breaking the bolt."

* From the London Artizan, for November, 1850.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, November 21st, 1850.

S. V. Merrick, President, in the chair.

Thomas Fletcher, Vice President.

Isaac B. Garrigues, Recording Secretary.

John F. Frazer, Treasurer.

The minutes of the last meeting were read and approved.

Letters were read from The Royal Institution, and The Royal Society, London; John Fagan, Esq., Winchester, Va., and R. P. Gillingham, Philadelphia.

Donations were received from The Statistical Society, and The Chemical Society, London; Thomas Ewbank, Esq., Washington City, D. C.; Hon. Joseph R. Chandler, United States Congress; A. S. Barnes & Co., and Brady, d'Avignon & Co., New York; Dr. Robert Hare, Daniels & Smith, Henry Perkins, H. Whitall, The Controllers of the Public Schools, and John F. Frazer, Philadelphia, and John Fagan, Esq., Winchester, Va.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer's statements of the receipts and payments for the months of September and October were read.

The Board of Managers and the Standing Committees reported their minutes.

The Committee on Exhibitions presented their report on the late Exhibition of American Manufactures, held during the past month.

Resignations of membership in the Institute (72) were read and accepted.

Candidates for membership in the Institute (149) were proposed, and those proposed at the last meeting (17) were elected members of the Institute.

On motion, Professor John F. Frazer was authorized, in the absence of the Corresponding Secretary, to sign the Certificates of the *Third Premiums* awarded at the late Exhibition by the Committee on Exhibitions.

On motion, the letter from R. P. Gillingham, Esq., was referred to the Committee on Exhibitions.

Mr. John E. Addicks, from the Committee on Exhibitions, stated that the Committee in their report recommended to the Institute to award the *Gold Medal* to

The Sagamore Company, Portsmouth, N. H., for No. 1061—White and Colored Six Cord Spool Cotton; and to

Lippincott & Co., Philadelphia, Penn., for No. 3320—Specimens of Book-binding.

On motion, the above awards were made.

The Committee on Exhibitions presented the Report of the Judges on Lamps and Gas Fixtures, which was discussed, and referred back to the Committee.

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